GEOTECHNICAL INVESTIGATION
PROPOSED STEVENS CREEK FLOOD CONTROL IMPROVEMENTS
CENTRAL EXPRESSWAY TO SAN FRANCISCO BAY
SANTA CLARA COUNTY, CALIFORNIA

FOR

SANTA CLARA VALLEY WATER DISTRICT

December 8, 1981

Job No. 915-40

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December 8, 1981
Job No. 915-40

Santa Clara Valley Water District
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Attn: Mr. Mike McNeely, Division Engineer
Mr. Joe Pandit, Project Engineer

Subject: Geotechnical Investigation
Proposed Stevens Creek Flood Control Improvements
Central Expressway to San Francisco Bay
Santa Clara County, California

Gentlemen:

Transmitted herewith are twelve copies of our Geotechnical Investigation Report of the subject project. This study was performed in accordance with your authorization of the scope of service outlined in your contract for services dated June 11, 1981. The accompanying report presents our conclusions and recommendations, as well as the results of the soils exploration upon which they are based.

We appreciate the opportunity to be a consultant on this project and commend your professional approach and attitude. If we can be of further service or if you have any questions, please call us.

Respectfully submitted,

BERLOGAR, LONG & ASSOCIATES

Lenard D. Long

Lenard D. Long
Project Engineer

LDL/rw

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INTRODUCTION

This report presents the results of our Geotechnical Investigation for a portion of the Stevens Creek Flood Control Improvement project. This report is organized to first describe our understanding of the project; it then summarizes the services we performed, presents our interpretation of soil conditions, and provides our conclusions and recommendations. The remainder of the report is subdivided into two appendices as follows:

Appendix A - Field and Laboratory Data

Appendix B - NASA Fill Borrow Source

The area covered by this report is located with respect to the city of Mountain View and Moffett Field Naval Air Station as shown on the Vicinity Map, Plate 1. This portion of the Stevens Creek project is about 2½ miles in length extending from just north of the Central Expressway to approximately 2000 feet north of the existing Crittenden Lane Bridge. The major items of the proposed improvements which warrant geotechnical concern proposed for this portion of the project consist of the following:

1. Raising and widening existing levees on the west bank, in the reach just north of Central Expressway (stations 50+00 to 59+00).
2. Cut and cover for a 12-foot-diameter bypass pipe, approximately 200 feet in length, just south of Highway 101 (stations 103+00 to 105+00).

3. Constructing a 2- to 8-feet-high floodwall on the east bank adjacent to Moffett Field Housing and Ames Research Center (stations 117+00 to 141+00).

4. Constructing new levees, up to 17 feet in height, widening the channel to about 150 feet and raising existing levees from Highway 101 to about 2000 feet downstream (north) of Crittenden Lane Bridge. In addition, the channel will be deepened by excavating about 5½ to 6 feet deep from station 127+00 shallowing near Crittenden Lane. The new channel will contain depressed maintenance roadways.

5. Raising Crittenden Lane Bridge approximately 10 feet in height (station 169+30).

PURPOSE AND SCOPE OF SERVICES

The purpose of this Geotechnical Investigation is to explore and evaluate channel and levee conditions along the alignment from Central Expressway to San Francisco Bay in order to provide geotechnical conclusions and recommendations regarding the proposed improvements.

The scope of service performed for this investigation included consultation with the Santa Clara Valley Water District staff, site geologic reconnaissance, subsurface soil and geologic exploration (including test pits and borings), laboratory testing, engineering analysis and the preparation of this report which presents our conclusions and recommendations for the proposed project. In addition, we reviewed pertinent reports with geotechnical information covering this site and evaluated a proposed fill borrow source at NASA (see Appendix B). A detailed reference list is attached.

SITE CONDITIONS

Surface Conditions

Stevens Creek meanders from the foothills of the Santa Cruz Mountains north to San Francisco Bay. The portion of Stevens Creek which was subject to this investigation is underlain by alluvial fan deposits. In general, portions of Stevens Creek upstream of Highway 101 are undergoing downcutting and erosion while the lower portion is a depositional area. Present levees vary in height and slope; they show low to moderate indications of instability. A number of rodent borrows and holes were observed in existing levees. At various locations the channels contain dense vegetation, concrete drop structures, various slope protection features, such as sack concrete and concrete debris rip-rap.

Soil Conditions

The alluvial fan deposits which underlie this portion of Stevens Creek consist of interbedded and discontinuous layers of silty sands, silty gravels, sandy silts and silty clays. These soils are relatively dense or stiff.

In general, the particle size of the stream bed deposits decrease to the north as the creek approaches the Bay; this condition is a result of decreased stream velocity in the drowned estuary portion of this creek caused by ground subsidence from overdrafting of groundwater. Station 150+00 is near the upstream limit of tidal influence. Due to tidal influence particles tend to settle out in a very soft and loose state in the estuary portion (station 150+00 to San Francisco Bay).

Central Expressway to Moffett Boulevard - The channel banks and bottom soil conditions consist of interbedded layers of older alluvial silty clay, silty gravel, and silty sands. These materials are stiff, or dense and generally low to non-plastic. Some isolated clay layers are moderate to high in plasticity. The channel bottom is blanketed with a shallow (1½ ± foot) layer of recently deposited sandy gravel.

Moffett Boulevard to Santiago Trailer Park - The channel banks consist of 4 to 5 feet of expansive silty clay underlain by discontinuous and interbedded older alluvial layers of dense silty gravel and sand, and stiff silty clay. The channel bottom contains recently deposited, loose silty sand, sandy gravel and some soft silt sediments, up to 9 feet thick.

Santiago Trailer Park to End of Project - The channel banks generally contain mixed fill consisting of stiff and medium dense silty clay, silty sand and silty gravel. The natural topsoil consists of soft to medium stiff expansive silty clay with organics. The topsoil is underlain by discontinuous and interbedded layers of alluvial silty sand, sandy silt and silty clays. These soils are generally dense and stiff. The recently deposited sediments located in the channel consist of 9 to 10 feet of highly compressible silts and clays of very high plasticity and low density. In addition, large stumps, logs and limbs, and various stream debris are located within the sediments.

Groundwater

Groundwater was not observed during our site exploration in the portions of this project upstream of Moffett Boulevard; however, limited subsurface exploration was performed in this area because no major project changes are anticipated in this area. Groundwater was observed within a few feet of the bottom of the existing channel along the remainder of the alignment. We anticipate higher groundwater levels during winter and early spring.

FIELD EXPLORATION AND LABORATORY TESTING

We explored subsurface conditions along the alignment during the period June 24 through June 27, 1981 by excavating 23 backhoe test pits (3 to 12 feet deep), and by drilling 12 auger borings from 30 to 46 feet deep. We determined the test pit and boring locations shown on Plates 2 through 4 by pacing from existing fence lines. We estimated the ground surface elevations at the test pit and boring locations by interpolating between ground elevations shown on the project profile plans. These locations and elevations should be considered accurate only to the degree implied by the method used.

Our geologists logged the test pits and our engineers logged the borings; they obtained loose bulk and relatively undisturbed core samples. The logs of soil borings are shown on Plates 2 through 4. The logs of test pits are presented in Appendix "A"; soils are classified in accordance with the Unified Soil Classification System explained on Plate 5. A key to boring log and laboratory test symbols are shown on Plate 6.

We re-examined the samples in our laboratory to confirm the field classifications, and selected representative specimens for testing. Laboratory testing consisted of moisture content, dry density, strength (triaxial compression and direct shear), consolidation, compaction and classification (Atterberg Limits, grain size analysis, and shrink-swell) tests, as we deemed appropriate. The laboratory test results are summarized on Plates A1 through A12 of Appendix A.

CONCLUSIONS AND RECOMMENDATIONS

We conclude that, from a geotechnical engineering standpoint, the planned flood and erosion control improvements can be constructed essentially as planned. The main geotechnical engineering considerations affecting the design and construction of the project are as follows:

1. Performing grading operations during early spring
2. The presence of expansive soil and highly compressible sediments
3. Slope stability of new and existing channel banks
4. Construction of appurtenant structures
5. Subsidence due to lowering groundwater
6. Geologic hazards

These considerations are discussed in more detail in the following sections.

Grading

Our specific recommendations for site preparation and grading are presented on Plate 7.

We understand the District plans to construct this project in the early spring of 1982. It should be understood that high groundwater and saturated soil conditons anticipated at this time of year will make earthwork construction slow and costly. Most of the areas involving significant earthwork contain highly expansive on-site soils. During the wet season (winter and spring) these types of soils could have a moisture content which is 10 to 20 percent over optimum moisture content; they generally require drying back to within 4 to 6 percent of optimum moisture content to obtain the required compaction.

Downstream of the Santiago Trailer Park, our exploration encountered highly compressible silt and clay (Mud) sediments within the channel. These sediments are at moisture contents nearly 100 percent over optimum moisture content and will require a drag-line or large hoe to excavate. If these materials are to be re-used as compacted fill, they will have to be properly moisture conditioned. This could be accomplished by spreading the mud out in about a one foot lift for drying. Daily discing and mixing of the soil will decrease the anticipated drying time to about 3 to 4 weeks, depending on weather and temperature conditions. It will also produce relatively uniform moisture conditioning and a chance to remove debris (stumps, logs, limbs, etc.). During the fall of 1981 materials were excavated along the western portion of the channel as a part of this years maintenance program. These materials are being loosely dumped in an open area on the east bank (proposed levee area) in about a one foot lift for moisture conditioning. These materials should be removed and replaced as compacted fill during levee construction in accordance with the recommendations presented on Plate 7.

A good portion of the proposed on-site fill material is expansive. Levees constructed entirely of the expansive soil will develop desiccation cracks and experience slope creep from shrinking and swelling during periods of seasonal moisture change. This cracking and creeping could have a detrimental effect on long term slope stability. These adverse properties of the expansive soils can be effectively reduced by initially moisture conditioning them to a high moisture content (4 to 6 percent over optimum moisture content) and properly capping the soil with 18 inches of select fill having a low expansion potential.

Most of the expansive soils (clays and silts) are located in the channel downstream of about station 150+00, and near existing grade in the downstream portion of the project (below Moffett Boulevard), as well as the topsoil at the NASA borrow source. Low expansion potential soils (gravelly and sandy soils) are generally located within the channel above about station 150+00 and near grade above Moffett Boulevard. Some isolated strata of sands and gravels may be exposed in widening the channel downstream of station 150+00.

We understand that the volume of fill material required by this project will be approximately 158 thousand cubic yards. This large volume of material places great importance on the effort to balance the amount of material excavated with the amount of material needed as compacted fill. The wide range of existing density of materials and the variability of material types across the site plus the probable variations in construction techniques, precludes a precise estimate of the amount of excavation needed to provide the desired amount of compacted fill. On the basis of our investigation, we recommend the following earthwork balance figure be used in calculating grading quantities on this site. The shrinkage factors are presented by material type.

	VOLUME CHANGE FROM CUT TO FILL
	SHRINKAGE - PERCENT
	90% Compaction
Natural Materials and Existing Levees	6% to 10%
Existing Channel Sediments	53%

Slopes

Generally the natural and man-made slopes along this study zone contain soils with moderate to high strength characteristics, conditions favorable to slope stability. In embankment engineering, slope design generally requires safety factors in the range of 1.2 to 1.4. Higher safety factors are required if there is a risk of loss of human life, large uncertainty in soil parameters or limited maintenance programs. Our slope stability analyses were performed at various sections along the alignment which we consider to be critical. For instance, in the downstream section we assumed a new levee constructed at various slope ratios, approximately 17 feet in height consisting of compacted fill. In the upstream portions we assumed natural slopes up to 12 feet in height. For both procedures we used effective stress analysis with a circular slip surface and assumed the most critical period to be during draw-down, just after the 100-year flood.

The results of our analysis are presented on Plate 8. Therefore, we conclude that levees can be constructed of compacted fill material or natural slopes as steep as 2:1 (horizontal to vertical) with little risk of exceeding present maintenance requirements.

It is important to recognize the potential harmful effects of rodent burrowing in the proposed channel slopes. Rodent burrowing weakens the soil, provides for much deeper water penetration than would otherwise develop and could create piping problems. This will be a long-term maintenance problem if a rodent abatement program is not initiated.

Access Ramps and Depressed Maintenance Roadways

We understand that 18-feet-wide access ramps and depressed maintenance roadways will be constructed 4 feet or more above the channel bottom to allow maintenance equipment access within the channel. The equipment will be used to remove channel vegetation and sedimentation. Access ramps are proposed into the channel at approximate stations of 58+00, 111+00, 117+00, 140+00, 169+00 and 185+00. Maintenance roadways are proposed along the western banks from about station 111+00 to the downstream end of the project and on the east bank from about station 121+00 to the downstream end of the project.

Most of the maintenance roadways will be located in areas of firm natural soils or on existing levees. However, some of the roadways will be underlain partially by highly compressible channel sediments and partially by firm existing bank materials (existing levees or natural soils). The channel sediment located upstream of the Santiago Trailer Park generally consists of loose sands and gravels which should not experience significant settlement after engineering fabric and subgrade rock placement, and pose only minor maintenance problems. The channel sediments located downstream of the trailer park consist of soft and highly compressible saturated clays and silts. These highly compressible sediments will require stabilization to maintain their future integrity as a subgrade material. The following stabilization alternatives are provided in descending order of effectiveness and increasing maintenance:

1. Over-Excavation - remove all soft and compressible material, below and to a distance extending 7 feet beyond maintenance roadways, for their full depth. The excavation should then be backfilled with compacted fill materials. Shallow groundwater conditions could create problems during construction to place fill in-the-dry. It may be necessary to start at the downstream portion of the roadway by installing a cut-off wall across the channel to stop tidal influence. It could then be possible to work upstream using a dewatering trench or sumps with pumps, while excavation and replacement with compacted fill are done.

2. Displacement - Doze large volumes of aggregate fill from the edge of the channel toward the center, creating a mud wave to displace the soft and compressible soils. Because mud waves generally create some mixing of fill materials with mud, it would be necessary to use an engineering fabric (such as Marifi 140, Stabilok, Typar, or Supac 5-P) and crushed rock roadway section.

3. Bridging - The soft spongy compressible soils can be bridged by first placing an engineering fabric on the soft soil subgrade and then covering the fabric with at least 18 inches of crushed rock. Some displacement of the underlying mud should be anticipated, although the amount of displacement would be substantially less than in the "Displacement" method in paragraph 2 above. Lateral confinement should be provided by using flatter (5 horizontal to 1 vertical) interior slopes below the roadways, or by extending the fabric section 5 feet beyond the structural roadway section. This will minimize edge failures due to the highly compressible sediments.

Typical examples of the displacement and bridging methods are shown on Plate 9. During our discussions, you indicated that the most cost effective alternative will be a combination of 1 and 3 above. We propose removing soft, compressible soil to a minimum depth of 5 feet below finished grade; placing approved engineering fabric on the soft soil; covering the fabric with an 18 inch thick layer of material track-walked to provide a firm surface; placing two feet of compacted (90 percent) fill to subgrade. The subgrade is then to be blanketed with engineering fabric and capped with 18 inches of compacted crushed rock. The performance of other alternative sections such as increasing the thickness of track-walked material or replacing crushed rock with "armoring aggregate" (mixture of rock and soil) depends on the quality of materials used, methods of placement and how well they are compacted.

Settlement

A settlement analysis was performed to determine the effect of placing new compacted levee fills on the alluvial soils. The alluvial soils are moderate to slightly compressible for the anticipated earth loads. In-place channel sediments are highly compressible and should not be used under levees unless properly moisture-conditioned and compacted.

Generally new levees will be placed on preconsolidated, relatively dense alluvial deposits; little settlement (less than ¼ inch) is anticipated upstream of Crittenden Lane Bridge.

Downstream of Crittenden Lane Bridge, the levee height increases significantly and we performed our analysis assuming a new 17 feet high levee. Our analysis indicates that the total settlement should be less than 3 inches in this area. We did not encounter any "Bay Mud" during our exploration. However, an old 3 to 5 feet thick layer of silty clay with a high organic content was encountered at depths about 3 feet below existing grade at borings 10 and 12.

Crittenden Lane Bridge

Crittenden Lane Bridge is proposed to be raised about 10 feet. The District has in their files two as-built alternative bridge foundation plans*. One is for 30 inch drilled cast-in-place concrete piers and the other is for driven concrete piles, both plans are stamped "as-built". Our exploration revealed that the bridge is founded on 30 inch diameter drilled cast-in-place concrete piers. The concrete pier exposed during our exploration (upper 2 feet exposed just below pier cap) did not show obvious signs of structural distress of concrete degradation.

We back calculated the frictional capacity of the piers based on a 30 inch diameter, 19 feet of embedment as shown on the as-built plans and strength data obtained from our soil borings. Our analysis indicates the 30 kip design load per pier contains a factor of safety between 4 and 5. Normal safety factors for frictional piers vary from 1.5 to 3, depending on amount of uncertainty in soil parameters and type of structure to be supported.

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*Construction plans of zone NW-1 "northwest" project No. 1 and a portion of project No. 11, Stevens Creek Improvement, Central Avenue to Leslie Salt Evaporation Ponds, Santa Clara County Flood Control and Water Conservation District, Santa Clara County, dated June 16, 1960.

It is our opinion that the existing piers can be used for support of the new raised bridge provided the allowable load does not exceed 80 kips per pier. In addition, based on our analysis and elevations shown on the as-built plans and present profile, we recommend the following lateral pressures:

1. Passive Pressure 2000 psf (rectangular distribution)
    a. Abutment - Use below area with at least five feet of horizontal confinement (about elevation 4 feet M.S.L.)
    b. Pier - Use below elevation 0.0 feet M.S.L.
2. Active Pressure 90 pcf (equivalent fluid)

Floodwalls

A floodwall is presently proposed for this project and is to be located on the east bank along U.S. Government land (station 126+70 to 142+35). The walls will be from 2 to 8 feet in height.

Our exploration indicates the floodwall foundation soil will consist of highly expansive silty clay. To mitigate the adverse effects on the floodwall (tilting, heaving, etc.), we recommend the floodwall foundation consist of a continuous cast-in-place concrete footing. Design criteria for the foundation is presented on Plate 10. The proposed 12 inch wide footing excavation (maximum depth is 8 feet) should not, in our opinion, experience significant caving, provided that the elapsed time between excavation and concrete placement does not exceed 1 to 2 days. The possibility of encountered localized areas of unstable trench walls cannot be ruled out. Equipment and surcharge loads should be avoided within 10 feet of the trench.

Bypass Pipe/Box Culvert

A 200 foot long, 12 foot diameter bypass pipe line or alternatively a box culvert are being considered from approximately station 103+00 to 105+00, just south of the Bayshore Freeway. At the time of our field exploration, plans showed a pipeline located along the west bank; we now understand that an east bank alignment is being considered. Pacific Gas & Electric transmission towers are located on both sides of the channel and a gas line crosses the channel at this location. We understand the gas line will be relocated.

The west bank contains about 4 feet of stiff silty clay fill which is underlain by stiff to very stiff silty clay. After our field exploration we observed an open 4 feet deep PG&E trench on the east bank along the gas line alignment. The vertical trench walls consisted of silty sandy gravel fill materials. Since the fill was not explored in depth, no conclusions can be given as to its stability in deep excavations. Groundwater was encountered at a depth of 17 feet below the west bank ground surface. We consider the natural subsurface conditions favorable for cut and cover pipeline or box culvert installation procedures. The box culvert should be designed in accordance with the allowable bearing and lateral pressures shown on Plate 10. It is our opinion that a reasonable margin of construction safety can be obtained, against temporary open excavation slope instability, by excavating side slopes not steeper than 1 horizontal to 1 vertical; provided installation takes place during the dry season. A raise in groundwater and soil moisture conditions during winter and spring may require flatter temporary slopes.

Since the location of pipeline or box culvert excavations may be located within the influence of the transmission tower foundations, special precautions should be followed. Concrete pad footings for type "AH" tower (supplied by PG&E via SCVWD) indicate minimum footing depths of 4 feet. Soil should not be removed within a zone extending from the bottom of the footing outer edge at a slope ratio of 1½ horizontal to 1 vertical. If it becomes absolutely necessary to remove the soil within this zone, the footing should be underpinned or protected by sheet piling.

Erosion Criteria

Most of the project located upstream of Moffett Boulevard is experiencing downcutting from erosion whereas the portions downstream is a low velocity depositional area. The following are typical soil parameters for various sections of the project and are provided for your erosion analysis of stream beds and channel banks:

Location	USCS Classification	Plasticity Index	Angle of Repose	D75 Particle Size (mm)	D50 Particle Size (mm)
Station 50 to 90					
Channel Bank	CL	25	25°	.005	.001
Stream Bed	GW-GM	less than 10	34°	17	6
Station 90 to 150					
Channel Bank	CL	15	10°	.005	.001
Stream Bed	SM	less than 10	27°	11	4
Station 150 to 188					
Channel Bank	CH	40	10°	.005	.001
Stream Bed	MH	60	0°	.018	.004

Land Subsidence

From about 1915 to 1976 the land around the south bay and including Stevens Creek underwent subsidence due in part to groundwater withdrawal (Poland, 1971 and 1976). The piezometer water surface was lowered by as much as 185 feet in the Santa Clara Valley which resulted in a major increase in the effective overburden load on the water bearing (mostly fine-grained clay) beds in the confined system. The beds compressed under the increased stress and the land surface subsided as much as 7 feet between 1934 and 1967 in the vicinity of this project and up to 12.7 feet near San Jose.

Subsidence in the Santa Clara Valley has been controlled since 1967 so that natural recharge of the basin has increased the artesian head and reduced the overburden stress. If the artesian head is maintained at its present level, future subsidence should not occur. However, if groundwater withdrawal is reinstituted so that the artesian head is once again lowered, subsidence would be expected to occur again.

If subsidence occurs in the area under the Stevens Creek project, the height of the levee should be increased in relation to the amount of subsidence to maintain the 100 year flood elevation. The determination of the actual amount of additional levee height needed in the future depends on many unknowns, including amounts of rainfall, rate of groundwater withdrawal, water imports, drawdown time period, and thickness of compressible layer. When the artesian head is lowered 120 to 130 feet some renewed subsidence is expected. When the head is lowered below the 1967 elevation, a renewed rate of subsidence is anticipated.

We can only predict future performance based on past performance. Our literature research indicates that between 0.03 to 0.07 feet of subsidence could occur for each foot of reduced artesian head. We believe the added levee height should be placed in the future when the above factors can be more accurately estimated. However, because of your property constaints, it may be prudent to steepen the outboard face of channel slopes, say 1½:1, at this time so that in the event of subsidence, fill only has to be added to the top and inboard slope to stay within the property limit and maintain channel width.

Geologic Hazards

The San Francisco Bay Area is recognized by geologists and seismologists as one of the most active seismic regions in the United States. Major active faults in the area capable of producing a large magnitude earthquake include the San Andreas, Hayward and Calaveras faults which are located approximately 10 miles southwest, 10 miles northeast and 17 miles northeast of the site, respectively. The project area does not currently lie within a designated State of California Special Studies Zone (CDMG, 1976). No faults are shown on recent geologic maps to cross this portion of the channel nor was any evidence of surface faulting encountered along the project during our investigation.

In our opinion, the most serious potential geologic hazard at the site is ground shaking, which could be caused by a major earthquake on the San Andreas, Hayward, Calaveras or other large fault in the Bay Area.

Liquefaction is the temporary transformation of water-saturated granular material from a solid state to a liquid state as a result of an increase in the pore-water pressure due to intense ground shaking. Soils most likely to liquefy consists of well-sorted, fine-grained sand that is clean (relatively free of silt and clay size particles), loose and saturated. Loose sands were encountered during our exploration at two locations; one located above the groundwater level (test pit 22) and the other in the channel (sediments). No liquefiable soils were located in the borings. It is our opinion that liquefaction is generally not a problem for the proposed levees although it is possible that there may be localized areas which contain liquefiable materials.

Ritter and Dupre (1972) have mapped the portion of the San Francisco Bay that may be inundated by a tsunami. Their map indicates that this site would be affected only to a very small degree near the mouth of the stream. That is, the attenuation of the wave as it moves down the bay from the Golden Gate decreases the wave energy so that a run-up of only an inch or so might be expected; this wave would probably not be detected in Stevens Creek.

Additional Soil Engineering Services

To a degree, the performance of new slopes and appurtenant structures such as roadways, floodwalls, bypass pipelines, etc., is dependent upon the procedures and quality of construction. A project of this magnitude with highly variable soil conditions will require field decisions during construction to be made by the soil engineer most familiar with soil conditions so that timely modifications can be made, if appropriate. Therefore, we believe it would be highly advisable for us to provide consultation and on-site observations of the contractor's procedures and exposed soil conditions during construction.

A meeting with the contractor prior to grading to discuss procedures and methods of construction will facilitate the performance of the construction operation and minimize possible misunderstandings and construction delays.

INVESTIGATION LIMITATIONS

Our investigation is based on a surface reconnaissance, field exploration, review of available geological literature and prior geotechnical reports on the site, laboratory tests, and engineering and geologic analyses. The data accumulated during our investigation is believed to be representative of the total area; however, soil and geologic conditions may vary in character between test pits, borings and other points of examination. The conclusions and recommendations contained herein are professional opinions derivedin accordance with current standards of professional practice; no other warranty is expressed or implied.

Respectfully submitted,

BERLOGAR, LONG & ASSOCIATES

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Attachments: See Table of Contents

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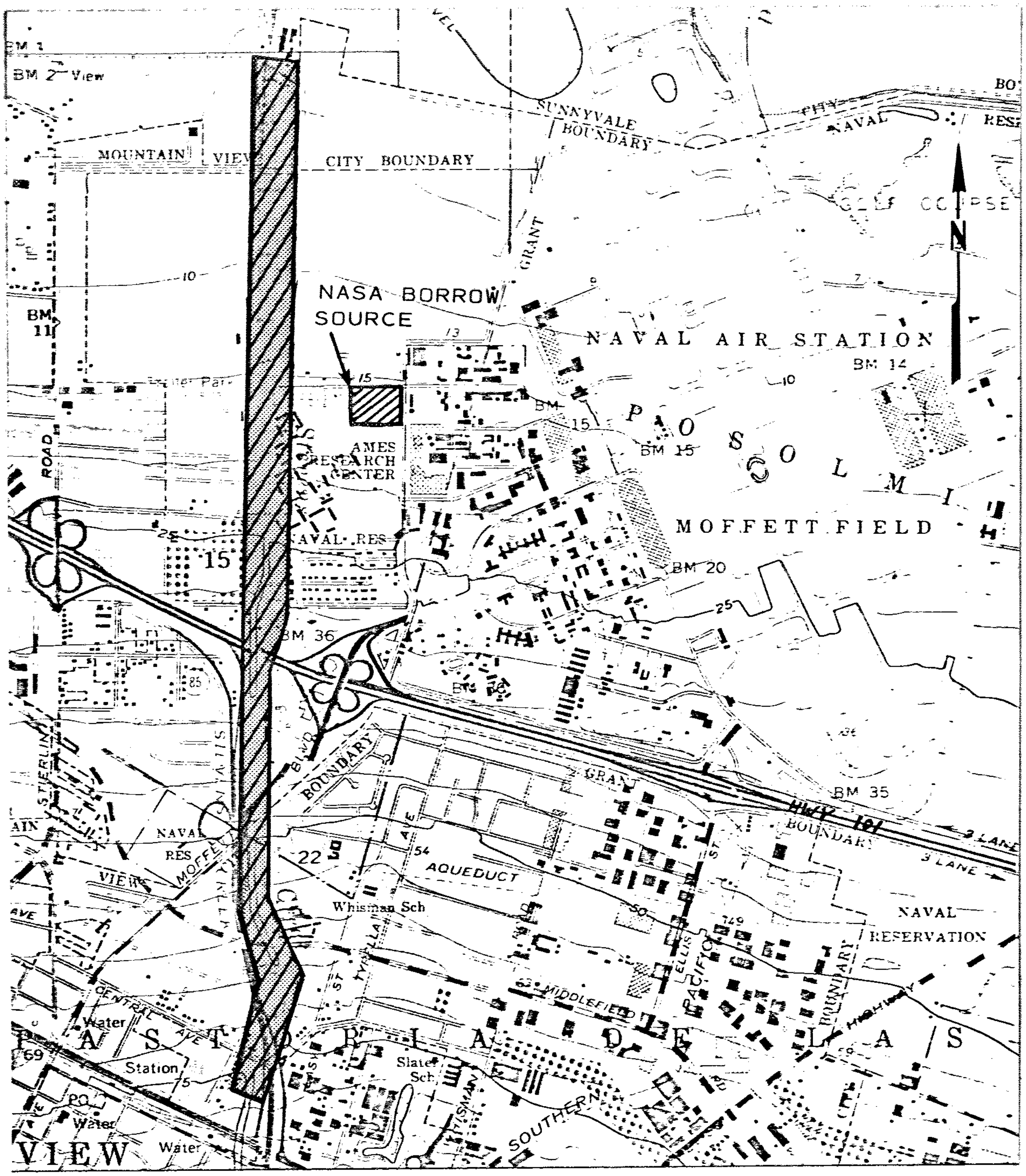


SCALE: 1"=2,000'

VICINITY MAP

STEVENS CREEK

CENTRAL EXPRESSWAY TO SAN FRANCISCO BAY

FOR

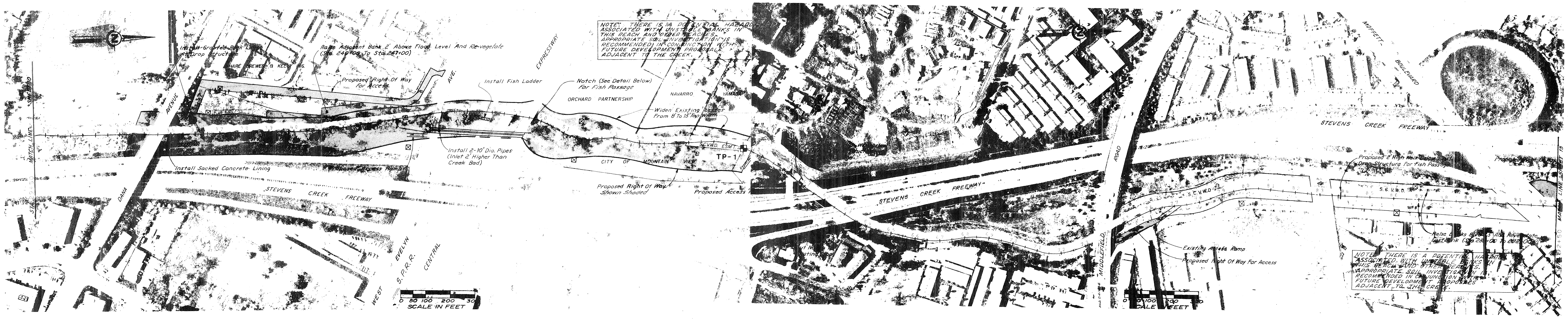
SANTA CLARA VALLEY WATER DISTRICT

BASE: PORTION OF U.S.G.S. MOUNTAIN VIEW, CALIFORNIA
7½-MINUTE TOPOGRAPHIC QUADRANGLES, PHOTOREVISED
1973, AT A SCALE OF 1:24,000.

PLATE 1

JOB NUMBER: 915-40

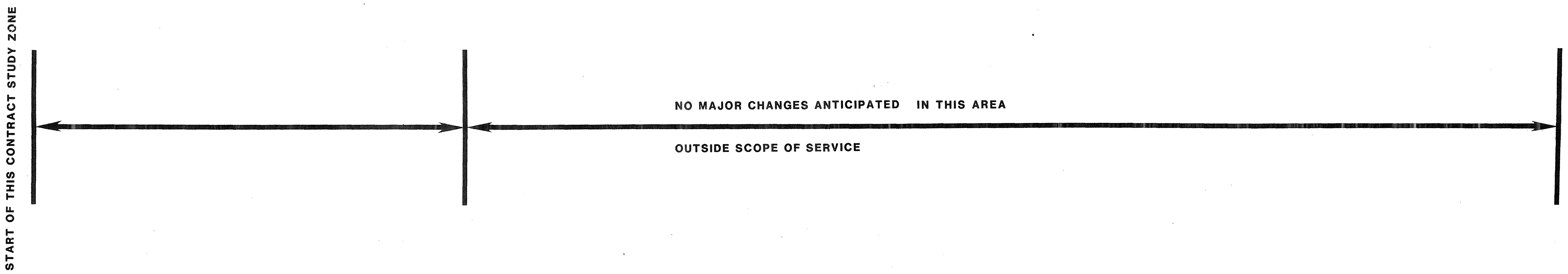
BY: LDL/BR



Install Grouted Rock Lining At Drop Structure
Raise Adjacent Bank 2' Above Flood Level And Re-vegetate (Sta. 240+00 To Sta. 247+00)
HARE BREWER & KELLY INC.
Proposed Right Of Way For Access
AVE.
EXPRESSWAY
Install Fish Ladder
Notch (See Detail Below) For Fish Passage
ORCHARD PARTNERSHIP
NAVARRO
YAMADA
Widen Existing Levees From 8' To 15' Top Width
MATCH LINE
STA. 229+50
AVENUE
DANA
Install Sacked Concrete Lining
Proposed Access Ramp
Install 2-10' Dia. Pipes (Inlet 2' Higher Than Creek Bed)
S.C.V.W.D. ESM'T.
TP-1
CITY OF MOUNTAIN VIEW
Proposed Right Of Way Shown Shaded
Proposed Access
STEVENS CREEK FREEWAY
WEST EVELYN
S.P.R.R.
CENTRAL
0 50 100 200 300
SCALE IN FEET
MOFFETT BOULEVARD
STEVENS CREEK FREEWAY
ROAD
MIDDLEFIELD
S.C.V.W.D.
Proposed 2' High Weir Below Drop Structure For Fish Passage
Proposed Right Of Way
Raise Banks & Re-vegetate East Bank (Sta. 280+00 To 282+00)
Existing Access Ramp
Proposed Right Of Way For Access
SCALE IN FEET
MATCH LINE SHEET 13
STA. 292+50

NOTE: THERE IS A POTENTIAL HAZARD ASSOCIATED WITH UNSTABLE BANKS IN THIS REACH AND OTHER REACHES. APPROPRIATE SOIL INVESTIGATION IS RECOMMENDED IN CONJUNCTION WITH FUTURE DEVELOPMENT PROPOSALS ADJACENT TO THE CREEK.

NOTE: THERE IS A POTENTIAL HAZARD ASSOCIATED WITH UNSTABLE BANKS IN THIS REACH AND OTHER REACHES. APPROPRIATE SOIL INVESTIGATION IS RECOMMENDED IN CONJUNCTION WITH FUTURE DEVELOPMENT PROPOSALS ADJACENT TO THE CREEK.



START OF THIS CONTRACT STUDY ZONE

NO MAJOR CHANGES ANTICIPATED IN THIS AREA

OUTSIDE SCOPE OF SERVICE

REV.	DESCRIPTION	DATE	APPR.	REFERENCE INFORMATION AND NOTES
				⊠ TEST PIT LOCATION

DATE 7/81

DESIGN

DRAWN

CHECKED

Santa Clara Valley Water District

ENGINEERING CERTIFICATION

PROJECT ENGINEER R.C.E. NO.

ENGINEERING APPROVAL

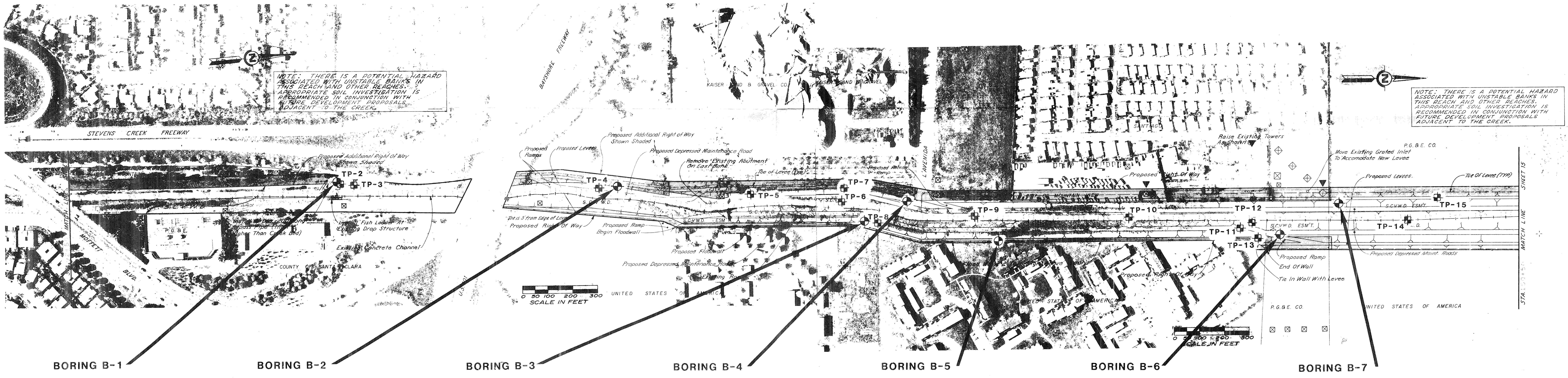
DIVISION ENGINEER R.C.E. NO.

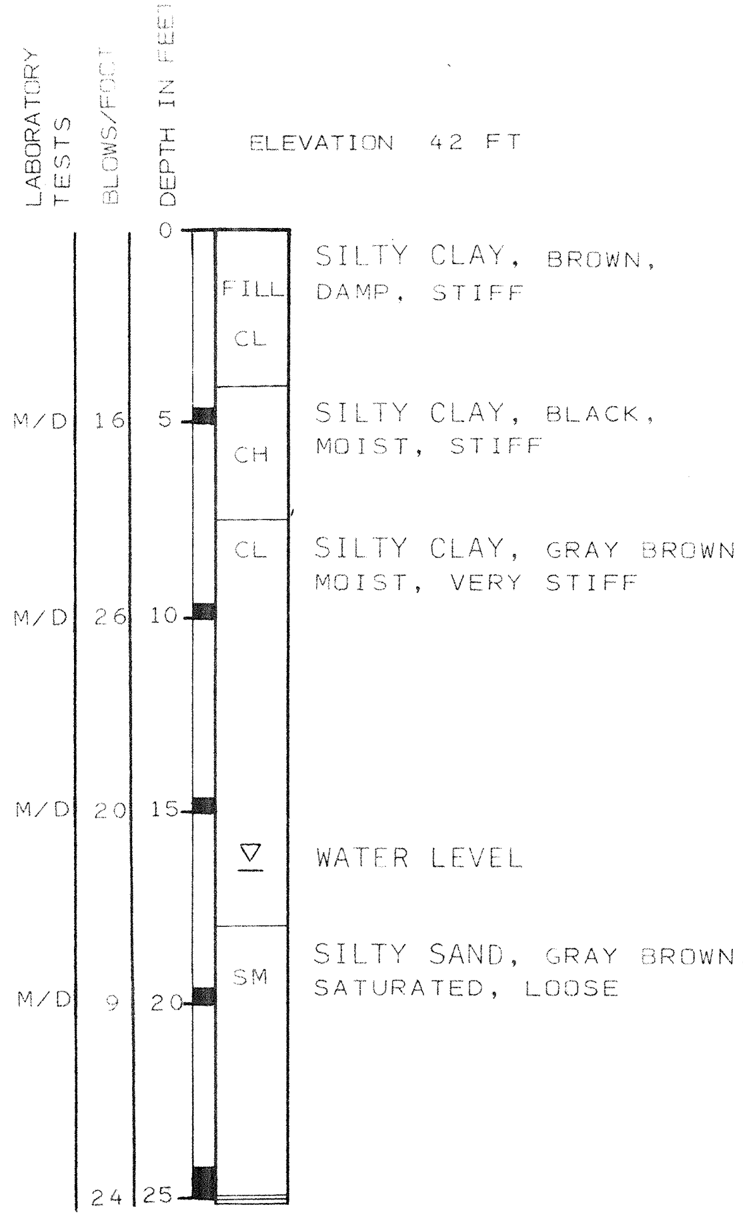
SITE PLAN
STEVENS CREEK
FLOOD CONTROL IMPROVEMENTS
CENTRAL EXPRESSWAY TO SAN FRANCISCO BAY
FOR
SANTA CLARA VALLEY WATER DISTRICT

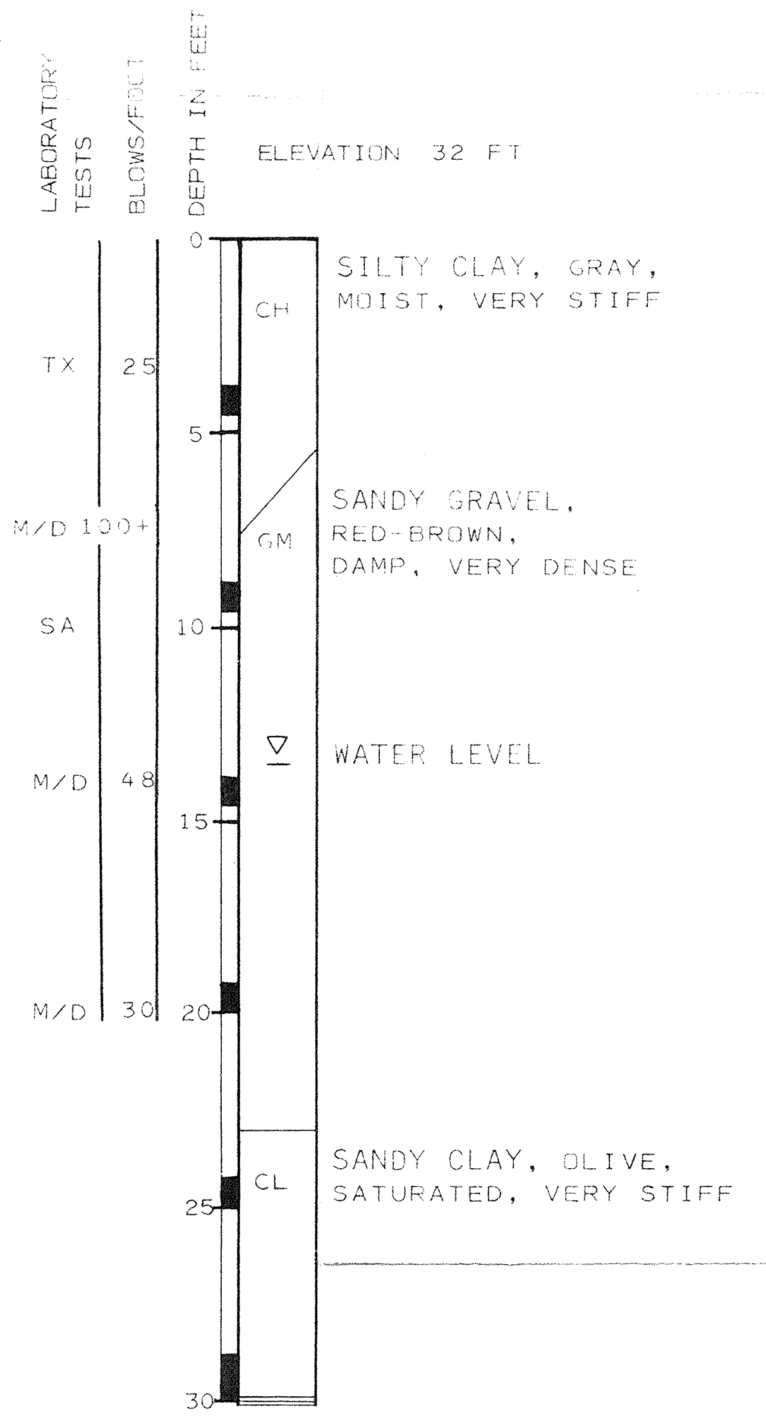
SCALE 1"=200'

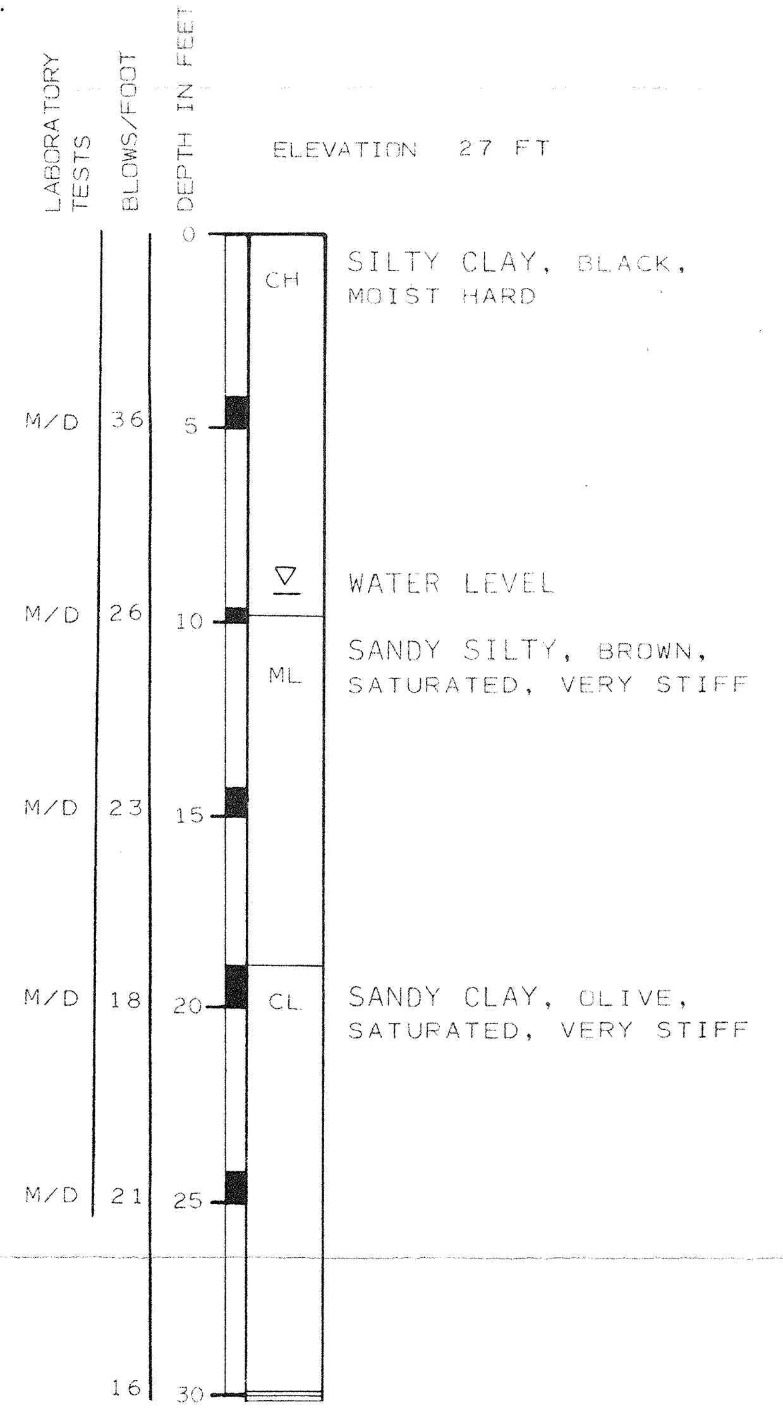
SHEET

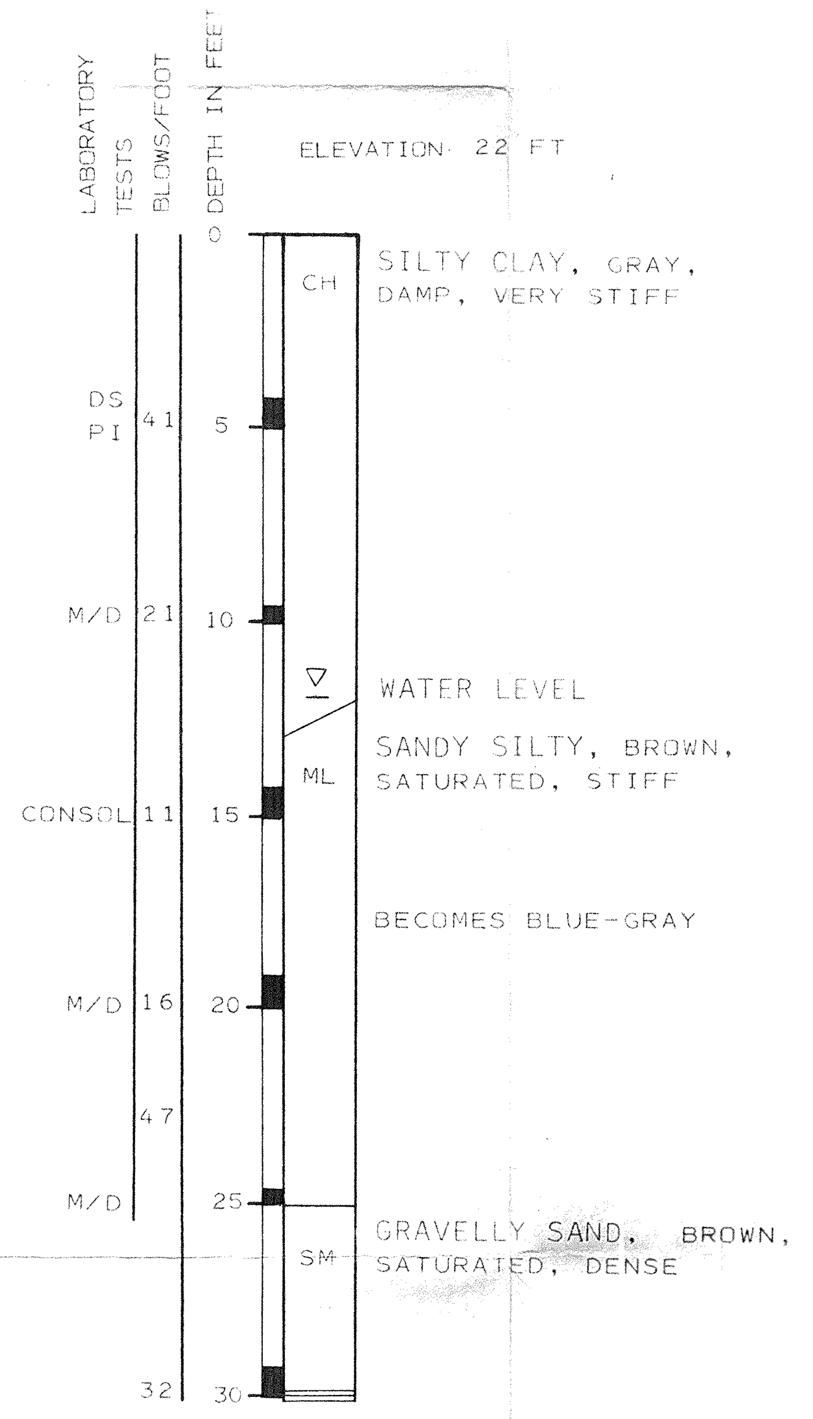
PLATE 2

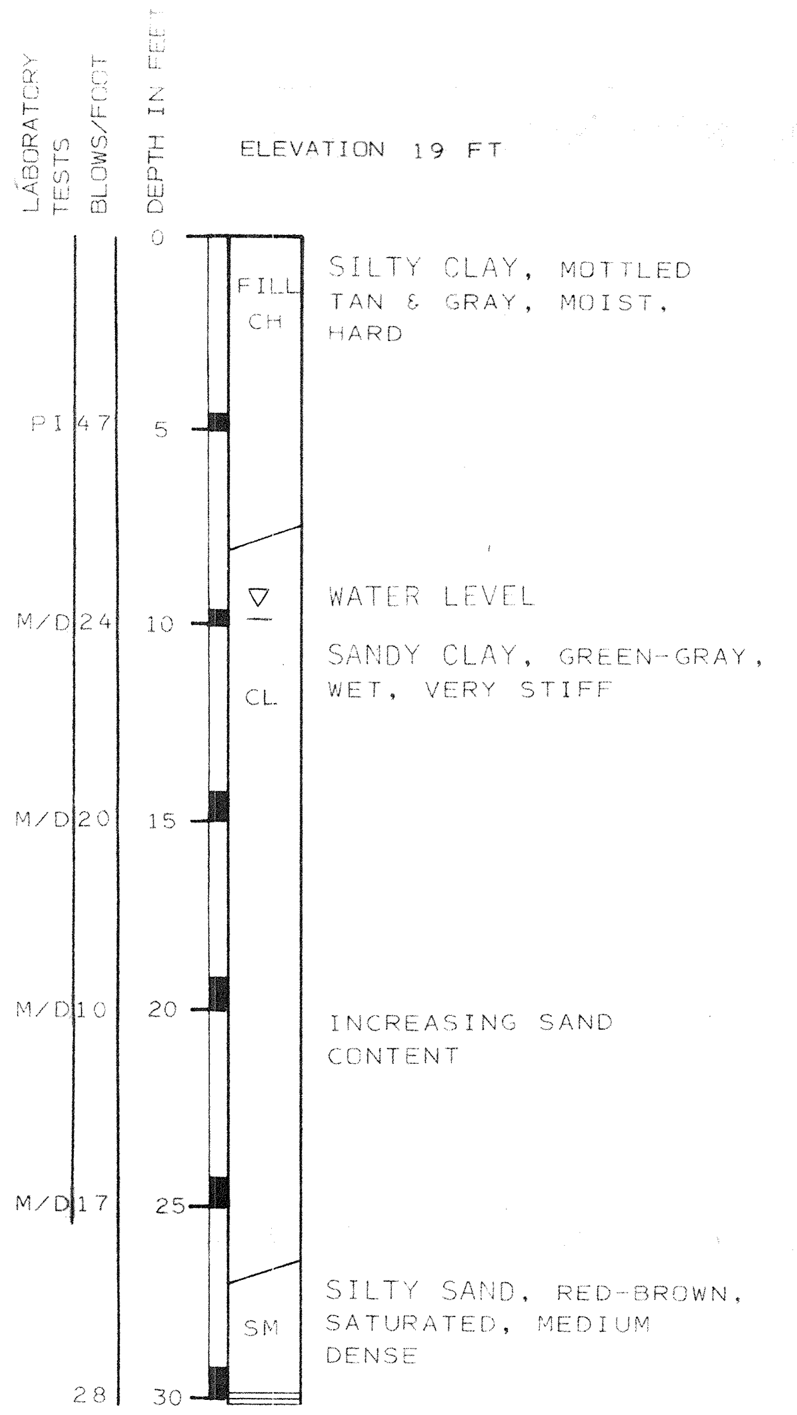


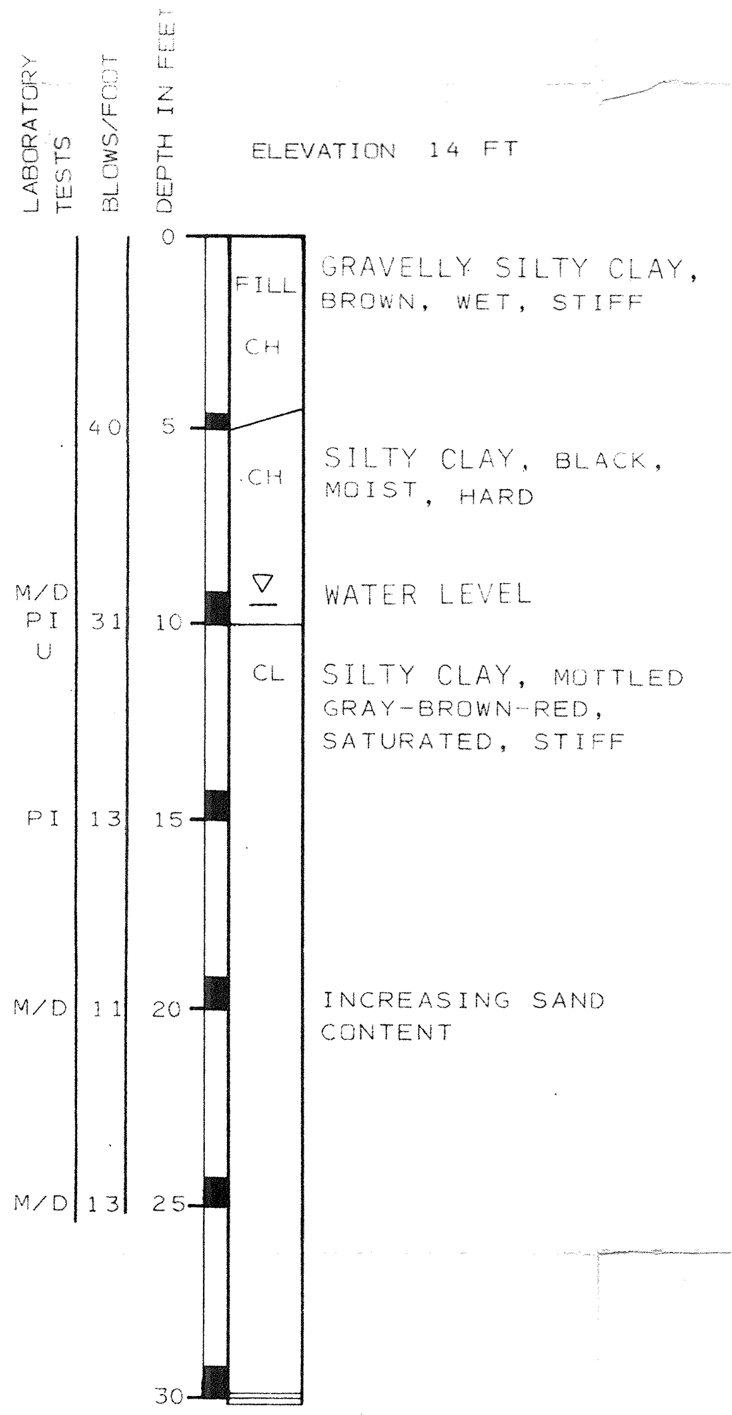

LABORATORY TESTS
BLOWS/FOOT
DEPTH IN FEET
ELEVATION 42 FT
0
FILL
CL
SILTY CLAY, BROWN, DAMP, STIFF
M/D 16 5
CH
SILTY CLAY, BLACK, MOIST, STIFF
CL
SILTY CLAY, GRAY BROWN, MOIST, VERY STIFF
M/D 26 10
M/D 20 15
WATER LEVEL
SM
SILTY SAND, GRAY BROWN, SATURATED, LOOSE
M/D 9 20
24 25

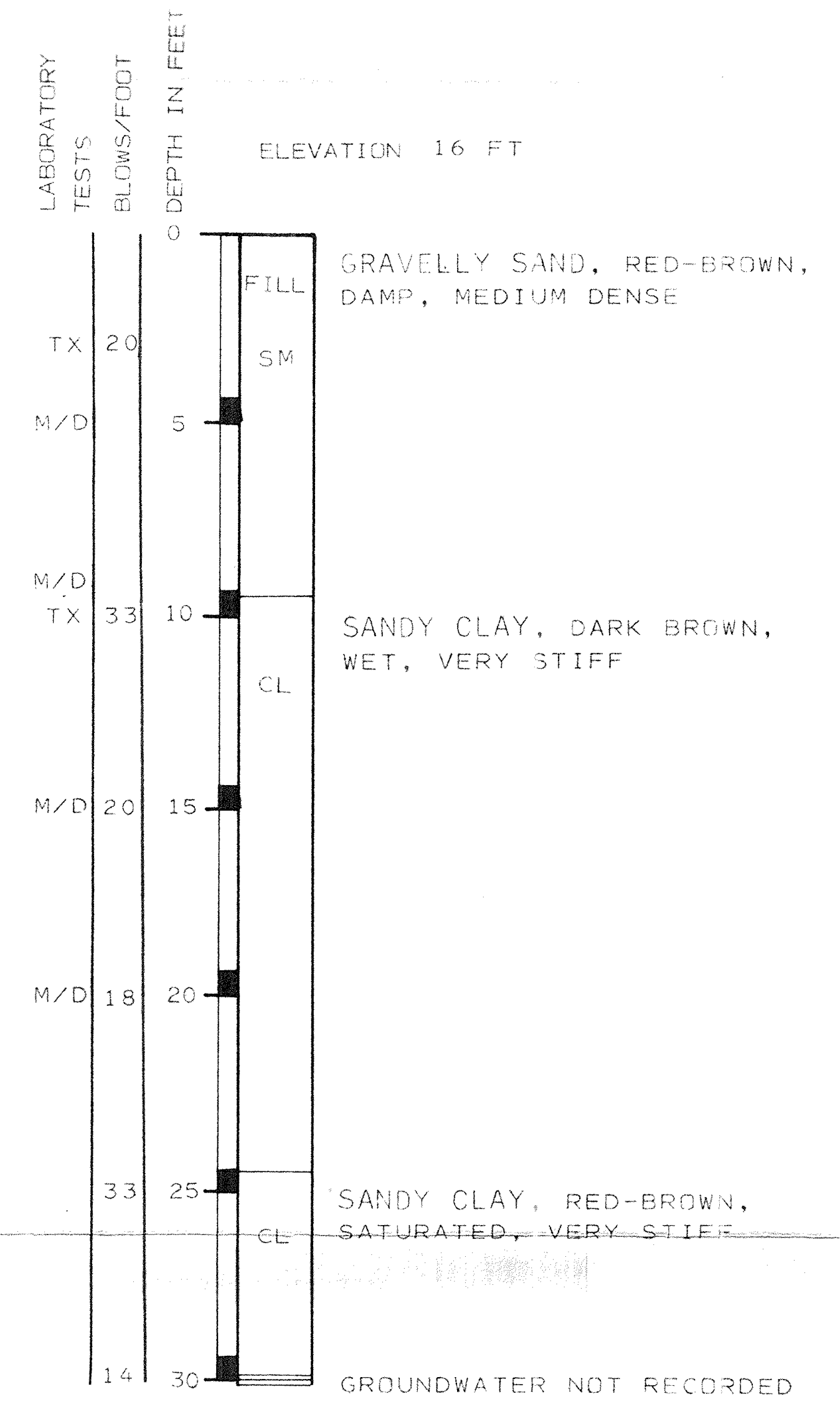

LABORATORY TESTS
BLOWS/FOOT
DEPTH IN FEET
ELEVATION 32 FT
0
CH
SILTY CLAY, GRAY, MOIST, VERY STIFF
TX 25
5
GM
SANDY GRAVEL, RED-BROWN, DAMP, VERY DENSE
M/D 100+
SA 10
WATER LEVEL
M/D 48 15
M/D 30 20
CL
SANDY CLAY, OLIVE, SATURATED, VERY STIFF
25
30











BY: I.DL/BR

JOB NUMBER: 915-40

REV	DESCRIPTION	DATE	APPR

REFERENCE INFORMATION AND NOTES

1. UNIFIED SOIL CLASSIFICATION SYSTEM IS EXPLAINED ON PLATE 5.
2. KEY TO BORING LOGS AND LABORATORY TESTS ARE EXPLAINED ON PLATE 6.
3. BORING ELEVATIONS ESTIMATED BY INTERPOLATING BETWEEN GROUND ELEVATIONS SHOWN ON THE PROJECT PROFILE PLAN.

⊕ BORING LOCATION

▣ TEST PIT LOCATION

DATE 7/81
DESIGN
DRAWN
CHECKED

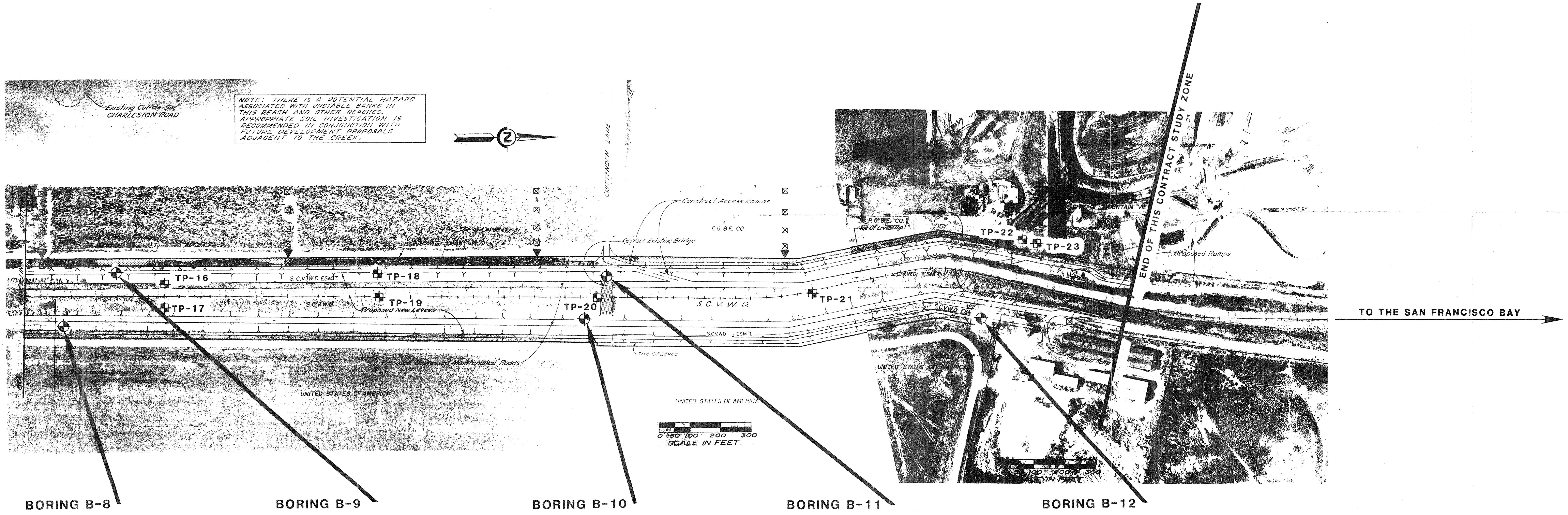
Santa Clara Valley Water District

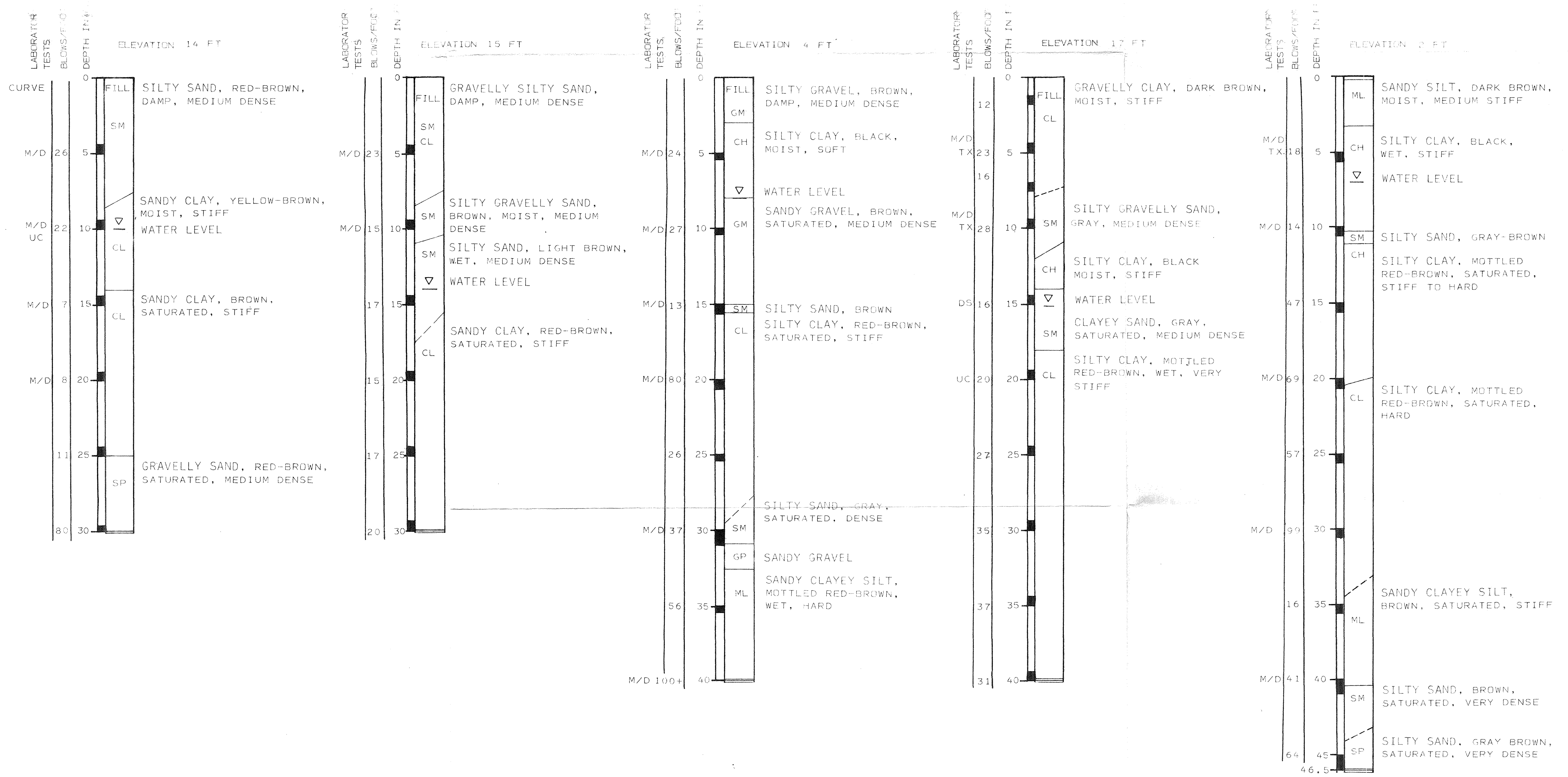
ENGINEERING CERTIFICATION
ENGINEERING APPROVAL

SITE PLAN
STEVENS CREEK
FLOOD CONTROL IMPROVEMENTS
CENTRAL EXPRESSWAY TO SAN FRANCISCO BAY
FOR
SANTA CLARA VALLEY WATER DISTRICT

SCALE 1"=200'
SHEET

PLATE 3




LABORATORY TESTS
BLOWS/FOOT
DEPTH IN FEET
ELEVATION 14 FT
CURVE
M/D 26
M/D UC 22
M/D 7
M/D 8
11
80
0 5 10 15 20 25 30
FILL
SM
CL
CL
SP
SILTY SAND, RED-BROWN, DAMP, MEDIUM DENSE
SANDY CLAY, YELLOW-BROWN, MOIST, STIFF
WATER LEVEL
SANDY CLAY, BROWN, SATURATED, STIFF
GRAVELLY SAND, RED-BROWN, SATURATED, MEDIUM DENSE
ELEVATION 15 FT
M/D 23
M/D 15
17
15
17
20
FILL
SM
CL
SM
SM
CL
GRAVELLY SILTY SAND, DAMP, MEDIUM DENSE
SILTY GRAVELLY SAND, BROWN, MOIST, MEDIUM DENSE
SILTY SAND, LIGHT BROWN, WET, MEDIUM DENSE
WATER LEVEL
SANDY CLAY, RED-BROWN, SATURATED, STIFF
ELEVATION 4 FT
M/D 24
M/D 27
M/D 13
M/D 80
26
M/D 37
56
M/D 100+
0 5 10 15 20 25 30 35 40
FILL
GM
CH
GM
SM
CL
SM
GP
ML
SILTY GRAVEL, BROWN, DAMP, MEDIUM DENSE
SILTY CLAY, BLACK, MOIST, SOFT
WATER LEVEL
SANDY GRAVEL, BROWN, SATURATED, MEDIUM DENSE
SILTY SAND, BROWN
SILTY CLAY, RED-BROWN, SATURATED, STIFF
SILTY SAND, GRAY, SATURATED, DENSE
SANDY GRAVEL
SANDY CLAYEY SILT, MOTTLED RED-BROWN, WET, HARD
ELEVATION 17 FT
12
M/D TX 23
16
M/D TX 28
DS 16
UC 20
27
35
37
31
FILL
CL
SM
CH
SM
CL
GRAVELLY CLAY, DARK BROWN, MOIST, STIFF
SILTY GRAVELLY SAND, GRAY, MEDIUM DENSE
SILTY CLAY, BLACK MOIST, STIFF
WATER LEVEL
CLAYEY SAND, GRAY, SATURATED, MEDIUM DENSE
SILTY CLAY, MOTTLED RED-BROWN, WET, VERY STIFF
ELEVATION 2 FT
M/D TX. 18
M/D 14
47
M/D 69
57
M/D 99
16
M/D 41
64
0 5 10 15 20 25 30 35 40 45 46.5
ML
CH
SM
CH
CL
ML
SM
SP
SANDY SILT, DARK BROWN, MOIST, MEDIUM STIFF
SILTY CLAY, BLACK, WET, STIFF
WATER LEVEL
SILTY SAND, GRAY-BROWN
SILTY CLAY, MOTTLED RED-BROWN, SATURATED, STIFF TO HARD
SILTY CLAY, MOTTLED RED-BROWN, SATURATED, HARD
SANDY CLAYEY SILT, BROWN, SATURATED, STIFF
SILTY SAND, BROWN, SATURATED, VERY DENSE
SILTY SAND, GRAY BROWN, SATURATED, VERY DENSE

BY: LDL/BR

JOB NUMBER: 915-40

REV	DESCRIPTION	DATE	APPR

REFERENCE INFORMATION AND NOTES

1. UNIFIED SOIL CLASSIFICATION SYSTEM IS EXPLAINED ON PLATE 5.
2. KEY TO BORING LOGS AND LABORATORY TESTS ARE EXPLAINED ON PLATE 6.
3. BORING ELEVATIONS ESTIMATED BY INTERPOLATING BETWEEN GROUND ELEVATIONS SHOWN ON THE PROJECT PROFILE PLAN.

⊕ BORING LOCATION

⊞ TEST PIT LOCATION

DATE 7/81

DESIGN

DRAWN

CHECKED

Santa Clara Valley Water District

ENGINEERING CERTIFICATION

ENGINEERING APPROVAL

PROJECT ENGINEER R.C.E. NO.

DIVISION ENGINEER R.C.E. NO.

SITE PLAN
STEVENS CREEK
FLOOD CONTROL IMPROVEMENTS
CENTRAL EXPRESSWAY TO SAN FRANCISCO BAY
FOR
SANTA CLARA VALLEY WATER DISTRICT

SCALE 1"=200'

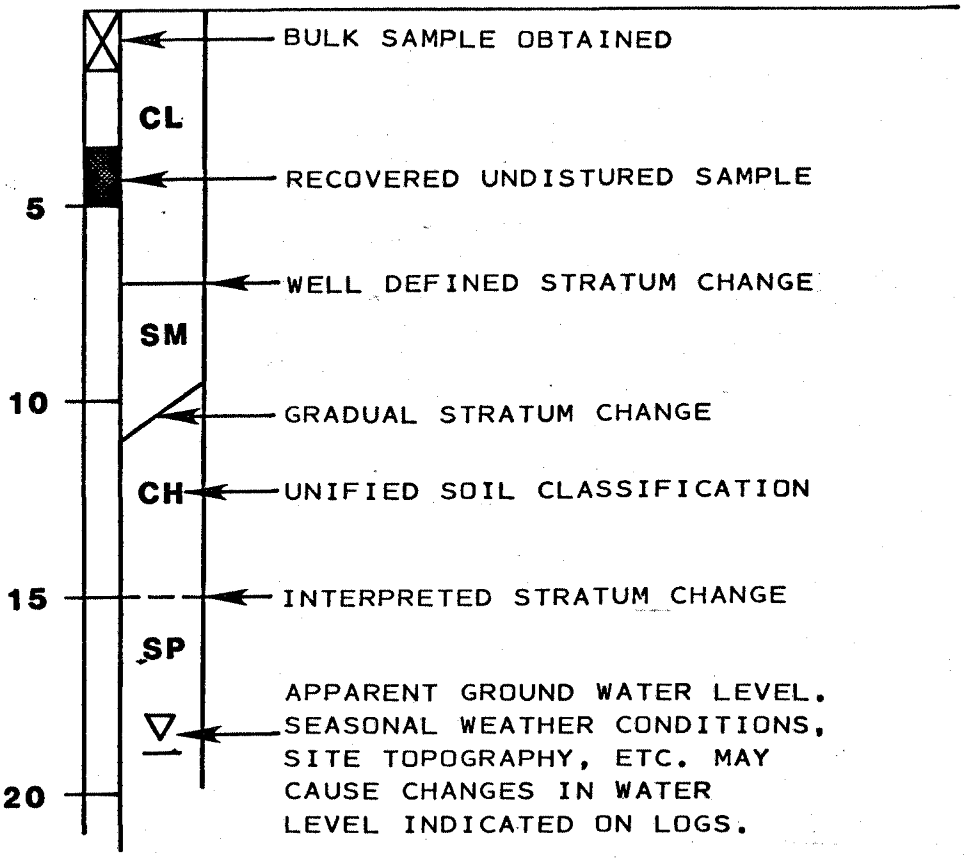
SHEET

PLATE 4

MAJOR DIVISIONS				TYPICAL NAMES
COARSE GRAINED SOILS MORE THAN HALF IS LARGER THAN #200 SIEVE	**GRAVELS** MORE THAN HALF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE SIZE	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL GRADED GRAVELS, GRAVEL - SAND MIXTURES
			GP	POORLY GRADED GRAVELS, GRAVEL - SAND MIXTURES
		GRAVELS WITH OVER 12% FINES	GM	SILTY GRAVELS, POORLY GRADED GRAVEL - SAND - SILT MIXTURES
			GC	CLAYEY GRAVELS, POORLY GRADED GRAVEL - SAND - CLAY MIXTURES
	SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE SIZE	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL GRADED SANDS, GRAVELLY SANDS
			SP	POORLY GRADED SANDS, GRAVELLY SANDS
		SANDS WITH OVER 12% FINES	SM	SILTY SANDS, POORLY GRADED SAND - SILT MIXTURES
			SC	CLAYEY SANDS, POORLY GRADED SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN HALF IS SMALLER THAN #200 SIEVE	**SILTS AND CLAYS** LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS, OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC CLAYS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACIOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS

UNIFIED SOIL CLASSIFICATION SYSTEM

KEY TO BORING LOG SYMBOLS


BULK SAMPLE OBTAINED
CL
RECOVERED UNDISTURED SAMPLE
5
WELL DEFINED STRATUM CHANGE
SM
10
GRADUAL STRATUM CHANGE
CH
UNIFIED SOIL CLASSIFICATION
15
INTERPRETED STRATUM CHANGE
SP
APPARENT GROUND WATER LEVEL. SEASONAL WEATHER CONDITIONS, SITE TOPOGRAPHY, ETC. MAY CAUSE CHANGES IN WATER LEVEL INDICATED ON LOGS.
20

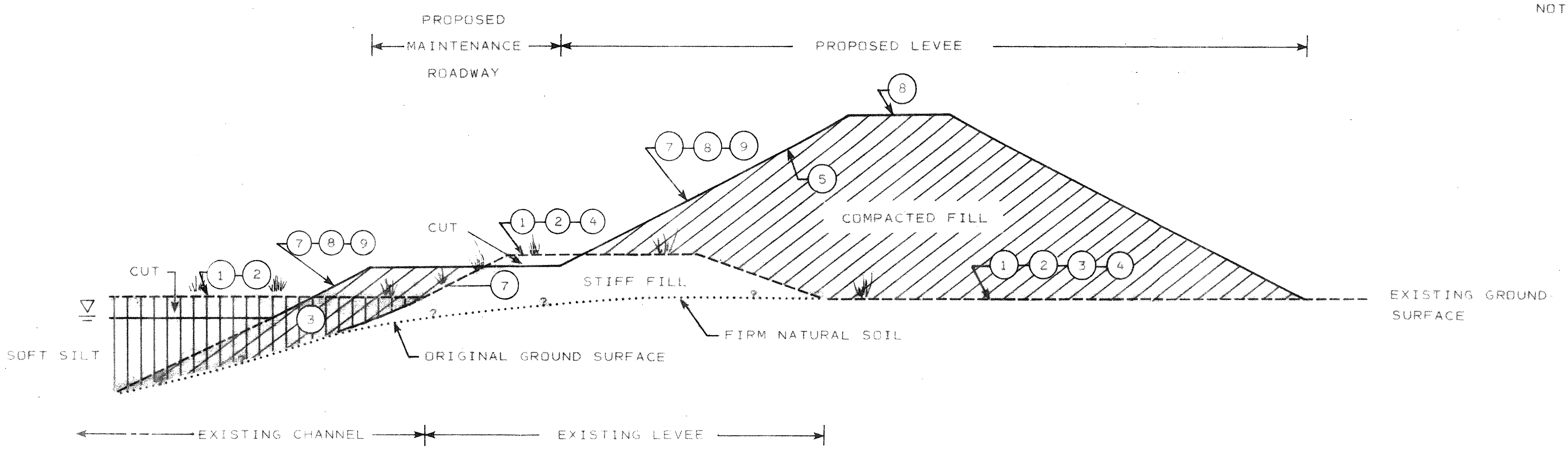
KEY TO LABORATORY TESTS

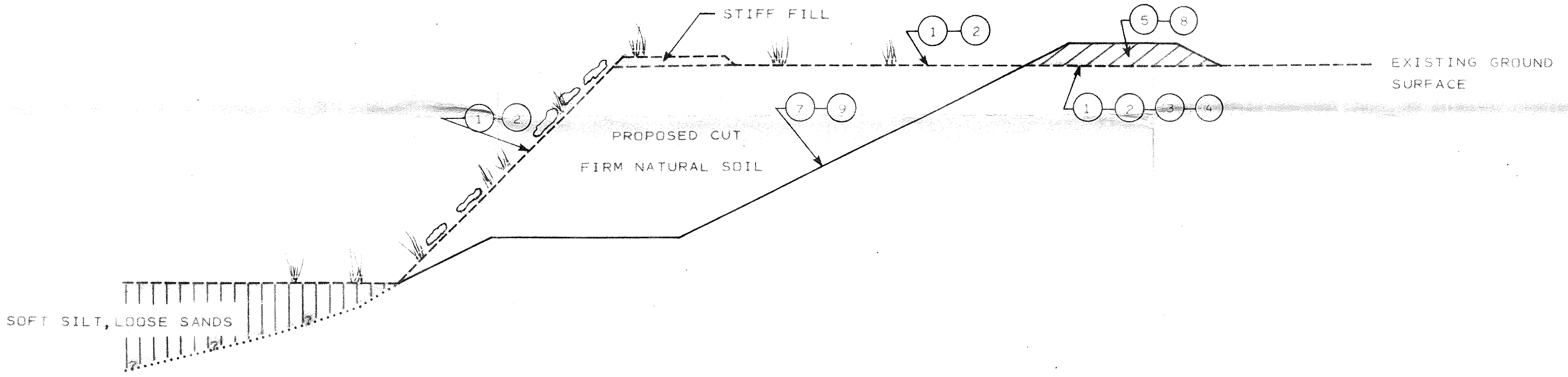
PI	ATTERBERG LIMITS
SA	SIEVE ANALYSIS
S/S	SHRINK/SWELL
DS	DIRECT SHEAR
UC	UNCONFINED COMPRESSION
TX	TRIAXIAL COMPRESSION
R-VALUE	R-VALUE
CONSOL	CONSOLIDATION
CURVE	COMPACTION CURVE
M/D	MOISTURE CONTENT/DRY DENSITY

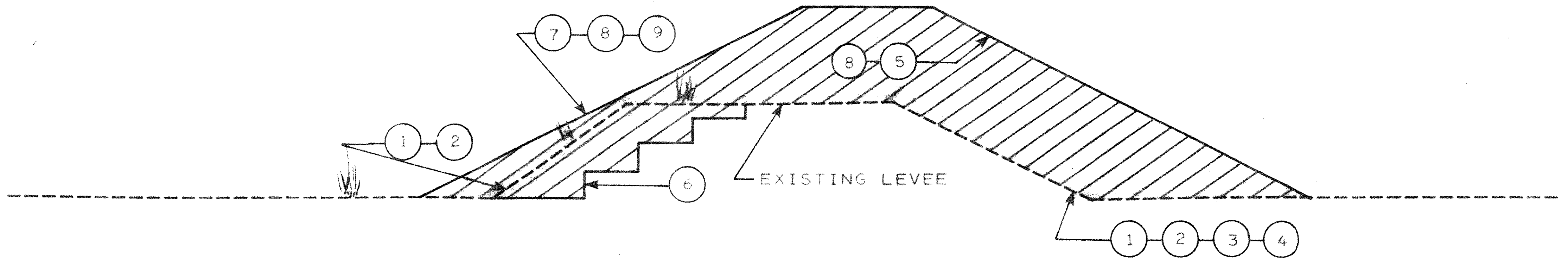
BY: BR

DATE: 7-16-81

JOB NUMBER: 915-40







NOTES:

1. ALL BRUSH, TREES, STUMPS, FENCES, CONCRETE AND DEBRIS SHOULD BE CLEARED FROM AREAS TO BE GRADED. LARGE ROCKS AND CONCRETE MAY BE STOCKPILED FOR REUSE AT THE COMPLETION OF GRADING AS RIPRAP SLOPE PROTECTION OR UNDER MAINTENANCE ROADWAYS.
2. AREAS TO BE GRADED SHOULD BE STRIPPED OF THE UPPER FOUR INCHES OF SOIL CONTAINING GRASS, ROOTS AND OTHER VEGETATION.
3. ALL ZONES OF SOFT AND/OR SPONGY MATERIAL AND DUMPED FILL SHOULD BE REMOVED FOR THEIR FULL DEPTH OR BRIDGED BY A STABILIZATION METHOD APPROVED BY THE SOIL ENGINEER
4. SCARIFY TO A DEPTH OF AT LEAST 6 INCHES; THEN MOISTURE CONDITION SOILS TO, AND MAINTAIN AT NEAR OPTIMUM MOISTURE CONTENT. COMPACT SOILS TO AT LEAST 90 PERCENT RELATIVE COMPACTION, BASED ON ASTM D1557-70(C) COMPACTION PROCEDURE.
5. LEVEE FILL SHOULD BE PLACED IN THIN LIFTS (6 TO 8 INCHES DEPENDING ON SIZE OF COMPACTION EQUIPMENT), MOISTURE CONDITIONED TO NEAR OPTIMUM CONTENT AND BE COMPACTED TO AT LEAST 90 PERCENT RELATIVE COMPACTION (85 PERCENT FOR EXPANSIVE SOILS).
6. AS THE FILL PROGRESSES UP SLOPE, LEVEL BENCHES SHOULD BE CUT INTO NATURAL BANKS OR EXISTING LEVEES TO EXPOSE FIRM SOILS. THE BENCHING PROCEDURE SHOULD BE APPROVED BY THE SOIL ENGINEER.
7. THE INSIDE CHANNEL SLOPE AND TOP OF LEVEES SHOULD BE CAPPED WITH AT LEAST 18 INCHES OF SELECT (LOW EXPANSION POTENTIAL) FILL AND BE UNIFORMLY COMPACTED TO AT LEAST 90 PERCENT RELATIVE COMPACTION. THE SURFACE OF THE SELECT FILL SHOULD BE FINISHED TO PROVIDE FIRM, SMOOTH, UNYIELDING SURFACE.
8. IMPORT SELECT FILL MATERIAL SHOULD BE FREE OF PERISHABLE MATERIAL AND CONFORM TO THE FOLLOWING REQUIREMENTS:

SIEVE SIZE	PERCENT PASSING (BY DRY WEIGHT)
6 INCH	100
4 INCH	90-100
NO. 200	15-60

LIQUID LIMIT ------- 40 MAXIMUM

PLASTICITY INDEX --- 15 MAXIMUM

MUCH OF THE ONSITE MATERIALS SOUTH OF STATION 150+00 CAN BE USED AS SELECT FILL PROVIDED THE ORGANICS AND EXPANSIVE SOILS ARE REMOVED.

9. ALL SLOPES SHOULD BE PLANTED WITH A SUITABLE GROUND COVER PRIOR TO WINTER RAINS TO MINIMIZE EROSION.
10. MATERIALS UNSUITABLE FOR USE AS ENGINEERED FILL, WHICH SHOULD BE HAULED OFF SITE OR WASTED OUTSIDE OF THE PROJECT AREA, IS THAT MATERIAL WHICH CONTAINS DEBRIS, TRASH, ROOTS, STUMPS, WEEDS, METAL, FENCES AND CONTAINS GREATER THAN THREE PERCENT ORGANICS CONTENT BY WEIGHT. ALL FILL SHOULD BE APPROVED BY THE SOIL ENGINEER.

RECOMMENDATIONS
SITE PREPARATION AND GRADING

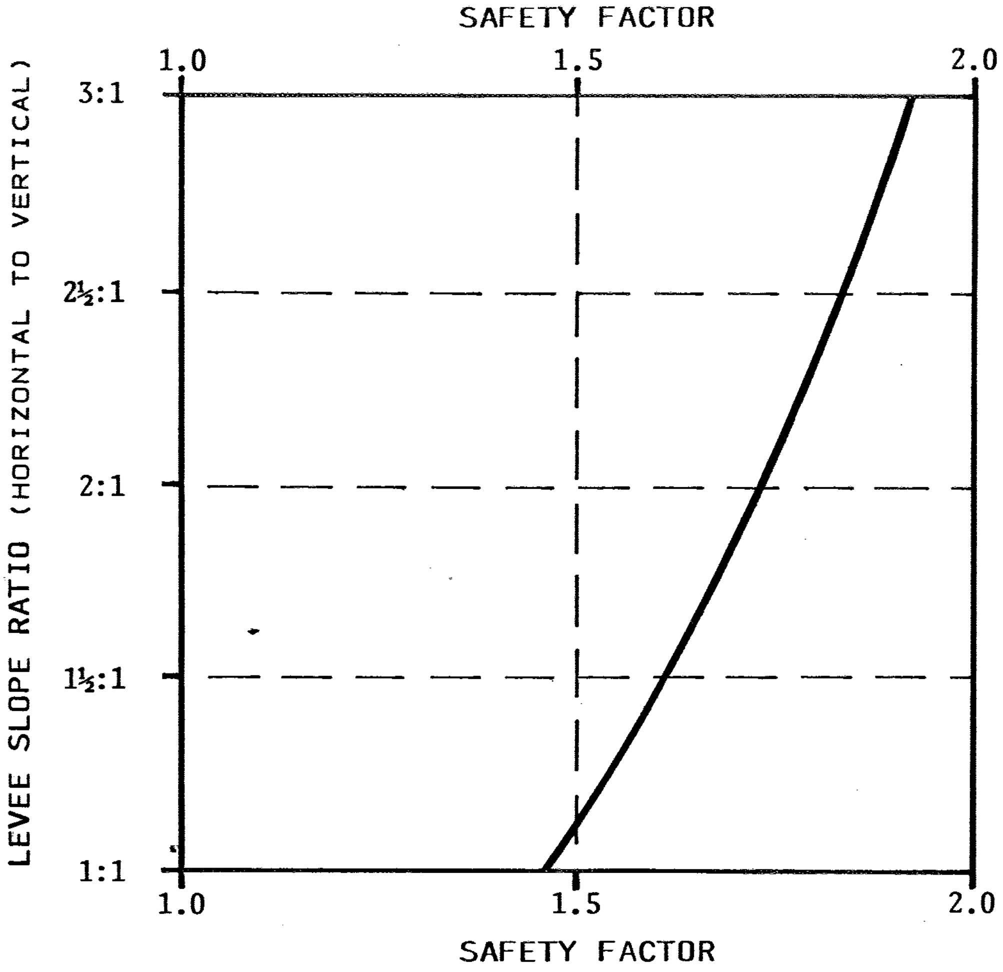
STEVENS CREEK IMPROVEMENTS

FOR

SANTA CLARA VALLEY WATER DISTRICT

BERLOGAR, LONG & ASSOCIATES
SOIL ENGINEERS • ENGINEERING GEOLOGISTS

Ⓑ BISHOP GRAPHICS/ACCUPRESS
REORDER NO. A-1315



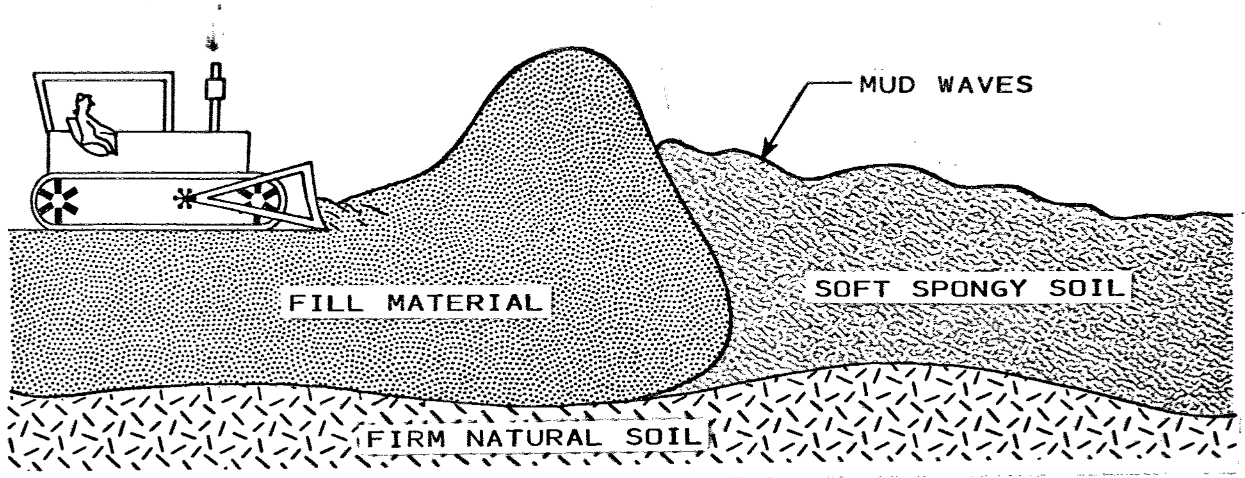
TYPICAL SLOPE STABILITY FACTORS FOR LEVEE EMBANKMENTS

NOTES:
1. COMPACTED FILL OR FIRM NATURAL SOIL
2. EFFECTIVE STRESS ANALYSIS WITH CIRCULAR SLIP SURFACE
3. STABILITY DURING DRAWDOWN

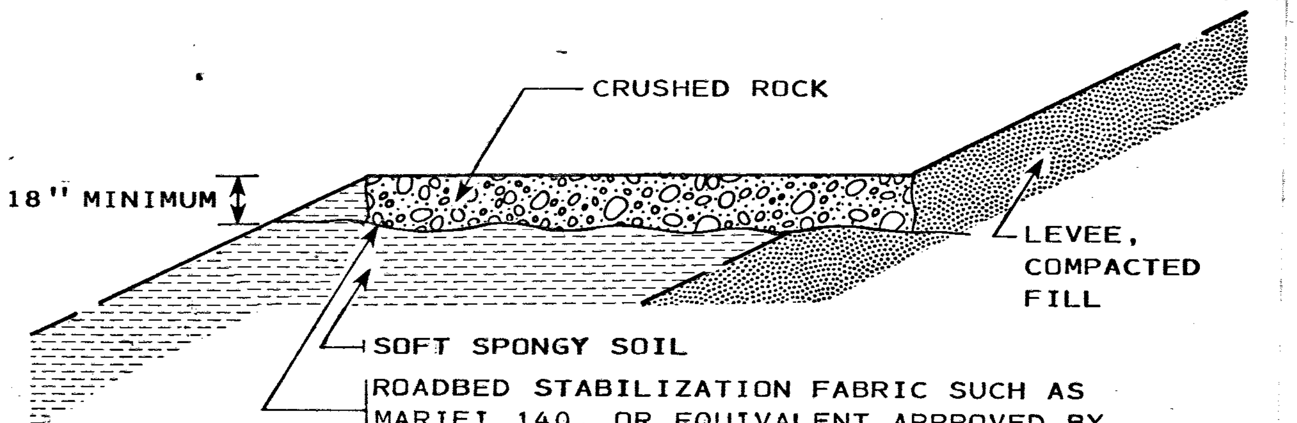
JOB NUMBER: 915-40 DATE: 10-30-81 BY: RV

JOB NUMBER: 915-40 DATE: 11-4-81 BY: RV ETC.

DISPLACEMENT METHOD



BRIDGING WITH FABRIC AND ROCK



ROADBED STABILIZATION FABRIC SUCH AS MARIFI 140, OR EQUIVALENT APPROVED BY THE SOIL ENGINEER. THE FABRIC SHOULD BE PLACED LONGITUDIALLY AND THE FABRIC JOINTS SHOULD OVERLAP MINIMUM OF 3 FEET.

CRUSHED ROCK

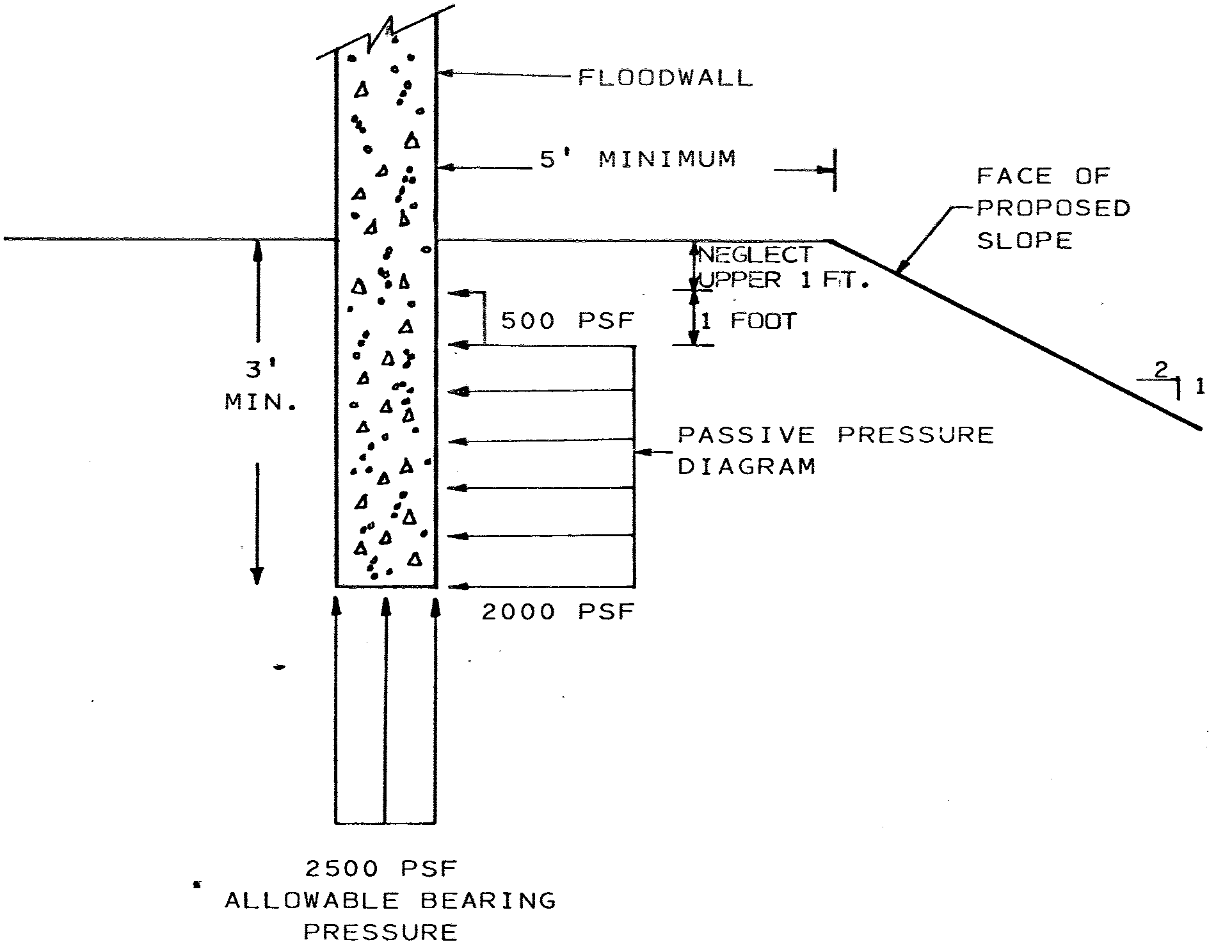
SIEVE SIZE	PERCENTAGE PASSING
3"	100
3/4"	30-60
NO. 40	0-10

TYPICAL DETAILS FOR ROADBED STABILIZATION

BY: BR

DATE: 9-21-81

JOB NUMBER: 915-40



NOT TO SCALE

RECOMMENDATIONS
FOR
FLOODWALL FOUNDATION

NOTES:

1. CONCRETE FOR FOOTINGS SHOULD BE PLACED AGAINST UNDISTURBED SOIL OR PROPERLY COMPACTED BACKFILL.
2. PASSIVE PRESSURES SHOULD BE NEGLECTED IN THE TOP FOOT. PASSIVE PRESSURE SHOULD ALSO BE NEGLECTED WHERE THERE IS LESS THAN 5 FEET OF HORIZONTAL CONFINEMENT BETWEEN THE FOUNDATION AND THE FACE OF SLOPE.
3. ACTIVE PRESSURE SHOULD BE CONSIDERED EQUAL TO AN EQUIVALENT FLUID OF 90 POUNDS PER CUBIC FEET. THIS IS TO BE USED AT THE ENDS OF THE RETAINING WALL WHERE FILL WILL BE PLACED AGAINST THE INSIDE CHANNEL WALL.

APPENDIX A

FIELD AND LABORATORY DATA

Job No. 915-40

TABLE A
TEST PIT LOGS

Test Pit Number	Depth (ft.)	Description
TP-1	0-1½	Sandy gravel, white to medium brown, moist, loose
	1½-8	Clay, mottled medium brown-orange, moist, soft, high plasticity
		Total depth 8', no groundwater
TP-2	0-½	Gravelly, clayey silt, light to dark brown, damp, stiff
	½-3½	Gravelly silty clay, dark brown-gray, damp, stiff to very stiff, moderate expansion potential, moderate to low plasticity
		Total depth 3½', no groundwater
TP-3	0-1	Fill, silty clay, mottled light and dark gray, slightly damp, very stiff but friable, high expansion potential
	1-3	Fill, silty sand, some gravel, fine-grained, medium brown, slightly damp, loose to medium dense
	3-5	Silty clay, mottled dark gray and dark brown, damp, stiff, large roots, moderate plasticity
	5-10	Silty clay, mottled medium gray and brown, damp, stiff, contains marine shells, moderate plasticity
		Total depth 10', no groundwater

TABLE A
TEST PIT LOGS

Test Pit Number	Depth (ft.)	Description
TP-4	0-2	Silty sand, gravel and concrete, dark gray, slightly damp, loose to medium dense
		Total depth 2', no groundwater
TP-5	0-1½	Sandy gravelly silt, medium brown, slightly damp, medium stiff to stiff, large tree roots
	1½-4	Fill, silt with sand and gravel, medium gray-brown, slightly damp, very stiff, indurated gravel is rounded cobbles, large
	4-12	Silty clay, medium gray with darker gray spots, mottled, moist, moderate plasticity, moderate to low expansion potential
		Total depth 12', no groundwater
TP-6	0-2	Gravel and sand lenses, dark gray, wet, very loose, mixed layers of gravel, well-rounded, fine- to medium-grained; and well-sorted, coarse-grained sand
		Total depth 2', groundwater at ½'
TP-7	0-3	Clay, mottled light and dark gray, damp, medium stiff, moderate plasticity, moderate expansion potential
	3-6	Clay, mottled medium brown and orange, moist, soft to medium stiff, moderate to high plasticity, moderate expansion potential
	6-14	Silty clay, mottled dark brown and dark orange, moist to wet, soft, moderate to high plasticity, moderate expansion potential
		Total depth 14', groundwater at 12'

Job No. 915-40

TABLE A

TEST PIT LOGS

Test Pit Number	Depth (ft.)	Description
TP-8	0-1	Fill, gravelly sand, medium gray-brown, slightly damp, dense to very dense, contains nails and other man-made material
	1-1½	Sandy gravel, medium gray-brown, slightly damp, loose to medium dense
	1½-6	Silty clay, light gray, damp, very stiff, mottled light and dark gray, low to moderate plasticity
		Total depth 6', no groundwater
TP-9	0-3	Gravel with coarse-grained sand, gravel well-rounded, up to 3" in diameter, very loose, dark gray, wet, poorly sorted
		Total depth 3', groundwater at 2'
TP-10	0-½	Silty sand, light brown, slightly damp, loose
	½-3	Gravel with sand, light brown, slightly damp, loose
	3-6	Sandy clay, dark gray-blue, wet, soft, moderate plasticity
		Total depth 6', groundwater at 2'
TP-11	0-2	Fill, sandy gravel, light gray-brown, slightly damp, loose to very loose, many roots
	2-6	Fill, gravelly, silty, sandy clay, light gray and orange, splotchy, moist to wet, stiff abundant roots
	6-8	Clayey sand, dark gray-brown, wet, loose
		Total depth 8', free groundwater at 8'

Job No. 915-40

TABLE A

TEST PIT LOGS

Test Pit Number	Depth (ft.)	Description
TP-12	0-3	Sandy gravel, dark gray, wet, very loose, sides of test pit caved in
		Total depth 3', groundwater at 1'
TP-13	0-½	Clayey, gravelly silt, light brown-gray, slightly damp, very stiff to hard
	½-2	Gravel and sand in alternating layers, mostly gravel, brown, damp, loose
	2-7	Silty clay, dark brown-gray, damp, stiff to very stiff, moderate plasticity
		Total depth 7', no groundwater
TP-14	0-¼	Sand, fine-grained, light to medium orange-brown, damp, loose, many roots
	¼-2½	Sandy clay, dark gray-blue, wet, soft, many roots, strong organic smell
	2½-3½	Gravel, well sorted, very loose, well rounded, gravel up to 3" diameter
	3½-5½	Clayey sand, light gray and orange, mottled, moist, medium dense, sand is fine-grained
		Total depth 5½', groundwater at 3'
TP-15	0-4	Fill, gravelly silt, light brown, slightly damp, stiff to very stiff
	4-11	Gravelly silt, medium to dark brown, damp, stiff
	11-12	Clayey sand, light gray to light brown, wet, loose
		Total depth 12', groundwater at 12'

TABLE A

TEST PIT LOGS

Test Pit Number	Depth (ft.)	Description
TP-16	0-3	Silt, light brown, slightly damp, soft
	3-9	Clay, dark blue-gray, moist to very moist, medium stiff, moderate expansion, potentially high plasticity, strong organic smell
	9-11	Sandy clay?, light gray and orange mottled, medium stiff, low to medium plasticity
		Total depth 11', groundwater at 7'
TP-17	0-¼	Sand, light brown-orange, moist, loose
	¼-3	Clay, dark gray-blue, wet, very soft, high plasticity, strong organic smell
		Total depth 3', groundwater at 2'
TP-18	0-4	Fill, mixture of sand, silt and some clay, light to medium brown, slightly damp, stiff
	4-7	Clay, dark gray-brown, moist, soft to medium stiff, high plasticity
		Total depth 7', no groundwater
TP-19	0-1	Sandy silt, light brown, damp, loose/soft
	1-5	Clay, very dark gray-blue, wet, very soft, moderate to high expansion potential, very high plasticity, strong organic smell
	5-7	Sand, light gray, wet, loose
	7-13	Sandy, gravelly clay, light gray and orange mottled, medium stiff
		Total depth 13', groundwater at 5'

TABLE A

TEST PIT LOGS

Test Pit Number	Depth (ft.)	Description
TP-20	0-2	Sand, fine-grained, light brown, slightly damp, loose, contains many pickle weed roots and man-made debris
	2-7	Silt, dark gray-blue, very moist, very soft, moderate to high expansion potential, high plasticity, strong organic smell
	7-10½	Clayey sand, light to dark gray to gray-blue, wet, loose
		Total depth 10½', groundwater at 7'
TP-21	0-½	Silt, light brown, slightly damp, loose
	½-4	Clay, dark blue-gray, moist, very soft, high expansion potential, very high plasticity, strong organic smell
	4-6	Sandy clay, dark gray, wet, soft, moderate expansion potential, moderate plasticity
	6-8	Sandy silt, light blue-gray, wet, soft, low plasticity
		Total depth 8', groundwater at 4'
TP-22	0-6	Fill, silty clay, very dark gray-black, slightly damp, hard, moderate plasticity
	6-10	Sand and fine-grained gravel layers, light brown, slightly damp, loose to very loose
		Total depth 10', no groundwater

Job No. 915-40

TABLE A

TEST PIT LOGS

Test Pit Number	Depth (ft.)	Description
TP-23	0-1½	Sand, fine-grained, light to medium (layered) brown, slightly damp, dense to very dense, fluvial
	1½-7½	Gravel, fine- to coarse-grained, damp, loose to very loose
	7½-8½	Sandy clay, dark blue-gray, moist, soft, high to moderate expansion potential, moderate plasticity
		Total depth 8½', no groundwater

Job No. 915-40

SUMMARY OF MOISTURE CONTENT AND DRY DENSITY
(ASTM D 2216)

Location	Depth	Moisture Content	Dry Density
B-1	4½	17.3	98
	9½	14.5	89
	14½	14.8	102
	19½	16.0	109
B-2	3½	25.0	85
	8½	10.4	102
	13½	7.0	107
B-3	4½	26.0	97
	9½	18.6	110
	14½	26.6	98
	19½	19.1	112
	24½	23.4	102
B-4	4½	24.2	82
	14	25.8	100
	19½	21.9	106
	24½	17.5	111
B-5	9½	17.5	108
	14½	21.6	109
	19½	27.4	98
	24	27.8	97

Job No. 915-40

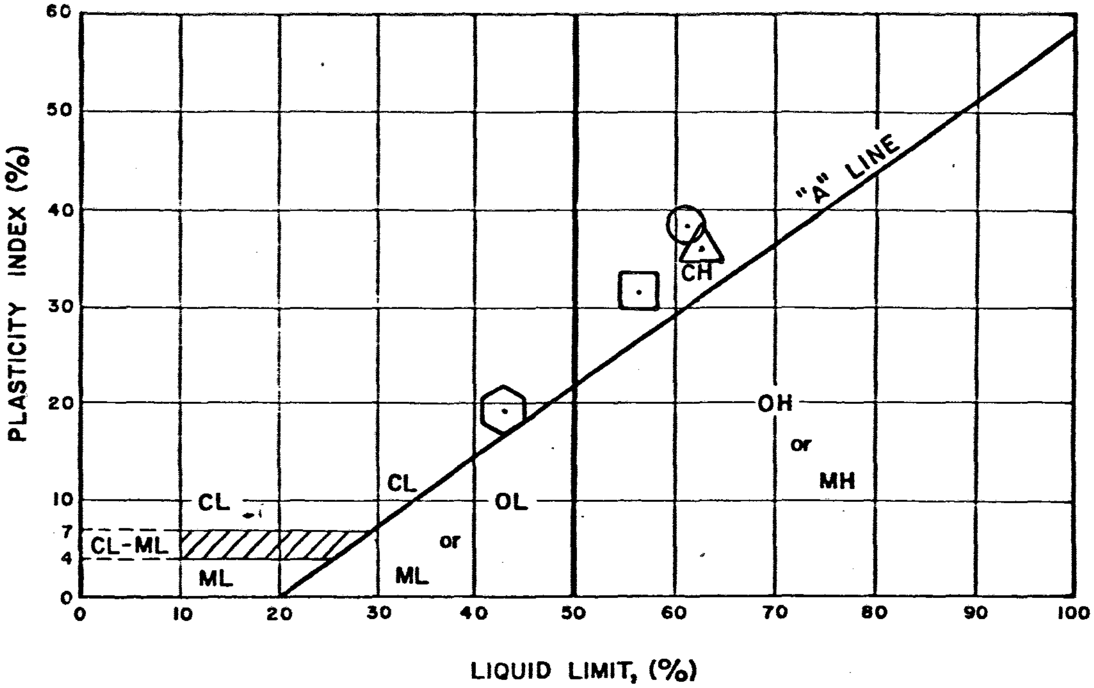
Location	Depth	Moisture Content	Dry Density
B-6	9½	18.2	108
	19½	12.1	125
	24½	20.5	102
B-7	4½	20.9	104
	9½	18.7	111
	14	22.3	102
	19½	30.2	92
B-8	4	8.1	112
	9½	14.7	110
	14½	21.6	102
	19	18.2	104
B-9	4½	15.3	108
	9½	9.4	-
B-10	5	13.6	121
	10	8.3	123
	15½	30.5	94
	20½	24.0	104
B-11	4	20.6	105
	10	13.6	118
B-12	5	31.2	90
	10½	18.0	116
	20½	18.2	113
	30½	18.7	111
	40½	21.8	106

Job No. 915-40

Location	Depth	Moisture Content	Dry Density
TP-1	4	119.1	92
TP-4	14	31.6	92
TP-20	2.8	113.9	41

JOB NUMBER: 915-40 LOCATION: MOUNTAIN VIEW DATE: 7-6-81 BY: RV CHECED BY: DATE:

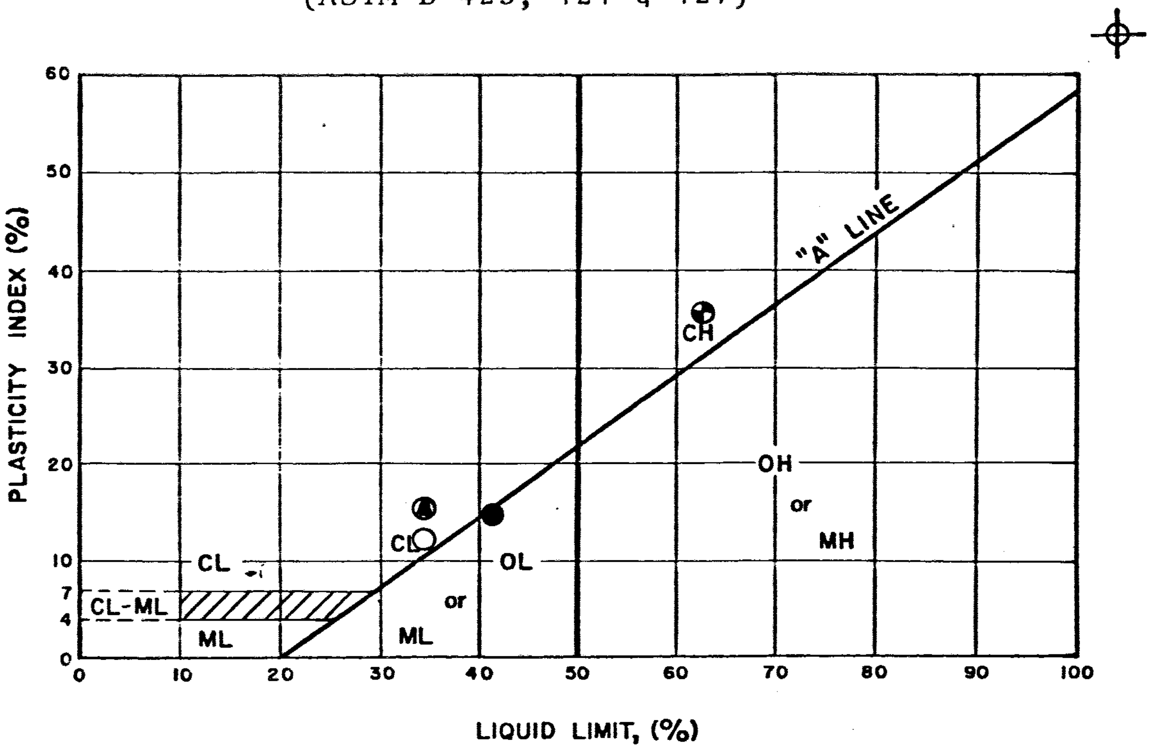
SUMMARY OF ATTERBERG LIMITS
(ASTM D 423 & 424)



SYMBOL	BORING NO.	DEPTH, FT.	LIQUID LIMIT, %	PLASTICITY INDEX, %	USC SYMBOL
○	B-4	4½	60.5	38	CH
□	B-5	4½	56.0	31	CH
△	B-6	4½	61.8	36	CH
⬡	B-6	14	43.4	19	CL

JOB NUMBER: 915-40 DATE: 7-8-81 BY: LDL

SUMMARY OF ATTERBERG LIMITS
(ASTM D 423, 424 & 427)



SYMBOL	BORING NO.	DEPTH, FT.	LIQUID LIMIT, %	PLASTICITY INDEX, %	USC SYMBOL	SHRINKAGE LIMIT %
◐	TP-1	6	63	35	CH	15
◬	TP-7	1	35	15	CL	16
○	TP-19	8	32	12	CL	30
⌖	TP-20	2-7	104	64	MH	26
●	TP-21	0-6	43	14	ML	25

EXPANSION - CONTRACTION TEST DATA

Sample Description	Test Surcharge psf	Moisture Condition	Moisture Content %	Dry Density pcf	% Expansion
B-5 @ 4½ ft	250	Prepared	28	94	--
Silty clay		After Saturation	29	93	+.1
		Air Dry	13	104	-11.3
		Oven Dry	0	106	-12.5

DESCRIPTION OF EXPANSION-CONTRACTION TEST PROCEDURE

A remolded sample of soil prepared at its optimum moisture content and 90 percent compaction based on ASTM Designation D 1557-70, confined in the 1-inch high, 2.40-inch ID cylinder, is immersed in water while under a surcharge pressure. Measurements of expansion or contraction are taken until movement ceases. The surcharge is removed and the sample air dried, then oven dried. By measuring the dimensions of the sample under these various conditions, it is possible to determine the soil volume under the following conditions: (1) at field moisture content; (2) when completely saturated under the given surcharge; (3) when air dry; and (4) when oven dry. The dry density is computed from the dry weight of the specimen and its volume under the various moisture conditions. The percent expansion, relative to the initial volume of the sample, is directly related to the various volumes and inversely related to the various dry densities of the sample.

Berlogar, Long & Associates

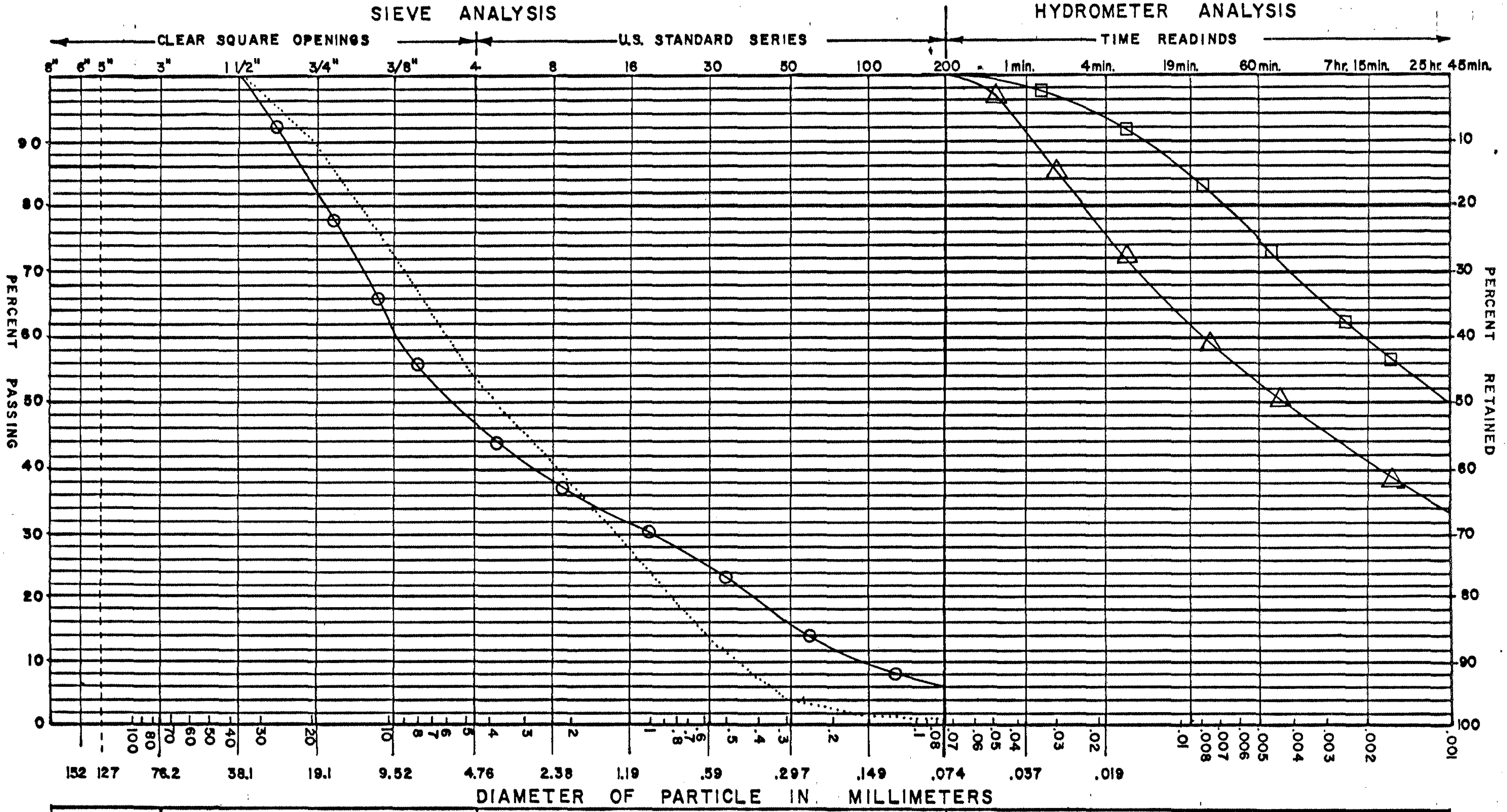
RESULTS OF GRADATION TEST

(ASTM E-11-70 & D 422)

JOB NO. 915-40

JOB NAME STEVENS CREEK

KEY	—○——○—	—□——□—	···········	—△——△—	
BORING NO.	B-2	TP-1	TP-6	TP-20	
DEPTH IN FEET	9'	4'	0-2'	3-8.'	
CLASSIFICATION	GW-GM	CH	SW	MH	



COBBLES	GRAVEL		SAND			SILT (NON-PLASTIC) TO CLAY (PLASTIC)
	COARSE	FINE	COARSE	MEDIUM	FINE	

PLATE A7

Job No. 915-40

COMPRESSION TEST RESULTS
(ASTM D 2166 & 2850)
UNCONSOLIDATED-UNDRAINED

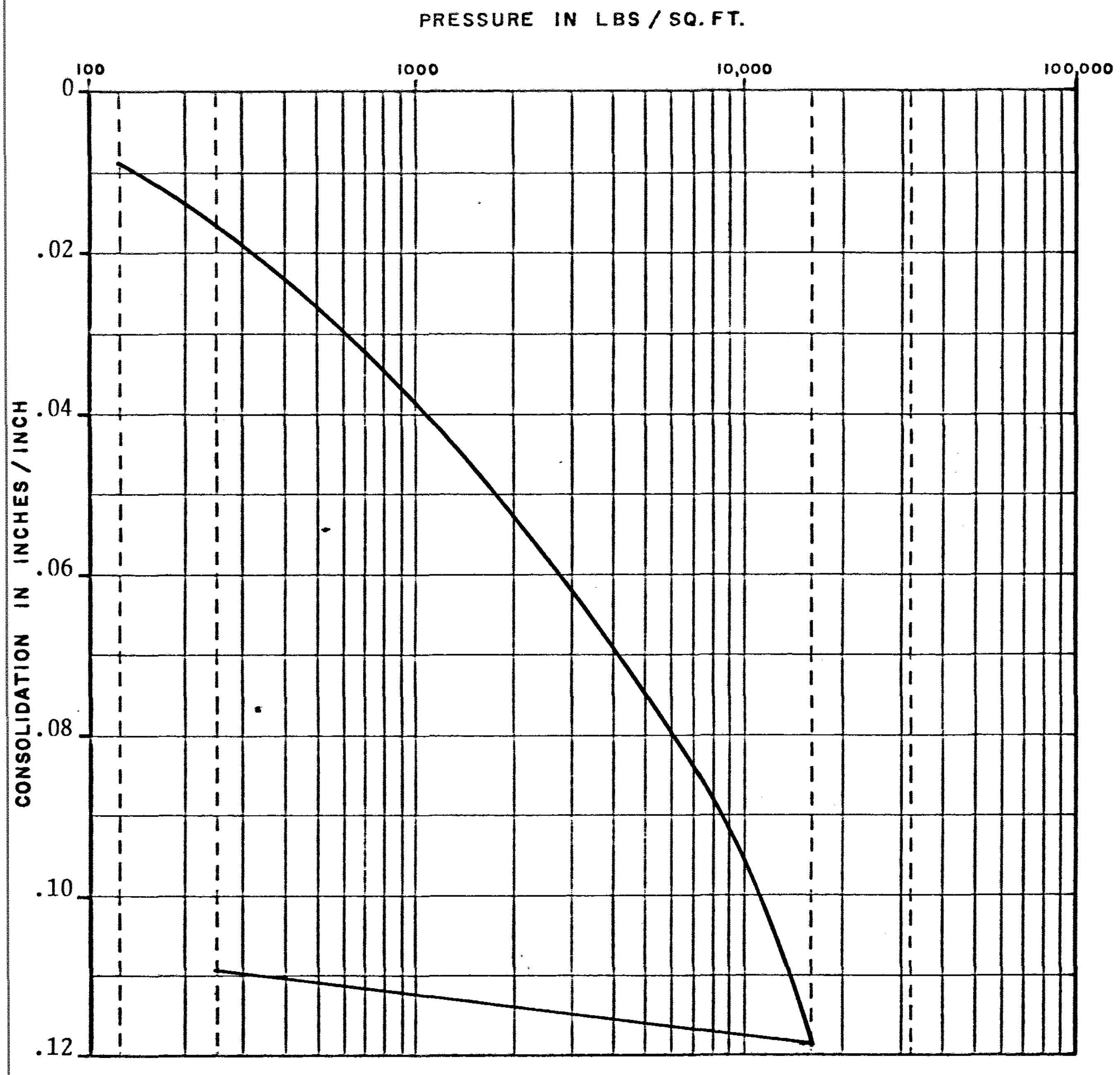
Sample Location	Dry Density	Moisture Content	Confining Pressure	Deviator Stress	Strain
B-2 @ 3½'	85	25	6.9 psi	11.7	16.9
B-6 @ 4½'	91	27	0	21.1	3.2
B-7 @ 4½'	104	21	6.9	21.3	9.7
B-7 @ 9½'	111	19	13.9	24.9	13.9
B-8 @ 9'	103	22	0	20.7	6.3
B-10 @ 20½'	104	24	6.9	32.14	10.8
B-11 @ 4'	105	21	3.5	21.1	13.0
B-11 @ 11'	118	14	6.9	21.4	20.0
B-11 @ 19½'	97	28	0	17.5	20.0
B-12 @ 5½'	111	20	13.9	18.2	9.5

DIRECT SHEAR TEST RESULTS
(ASTM D 3080)
CONSOLIDATED-DRAINED

Sample Location	Dry Density	Moisture Content	Normal Load(psf)	Shear Stress(psf)
B-4 @ 4'	81	40	750 1500 2200	614 971 1379
B-5 @ 14½'	105	29	700 1500 2200	945 1468 2118

DRAWN BY ______ DATE ______
CHECKED BY ______ DATE ______

JOB NUMBER 515-40 NAME SCVWD
LOCATION Stevens Creek



KEY	BORING	DEPTH	SOIL DESCRIPTION	NATURAL MOISTURE CONTENT%	NATURAL DRY DENSITY (P.C.F.)	EFFECTIVE OVERBURDEN PRESSURE (P.S.F.)	MAX. EFF. PAST PRESSURE (P.S.F.)
—	4	14	sandy silt, brown	26	100	Disturbed	

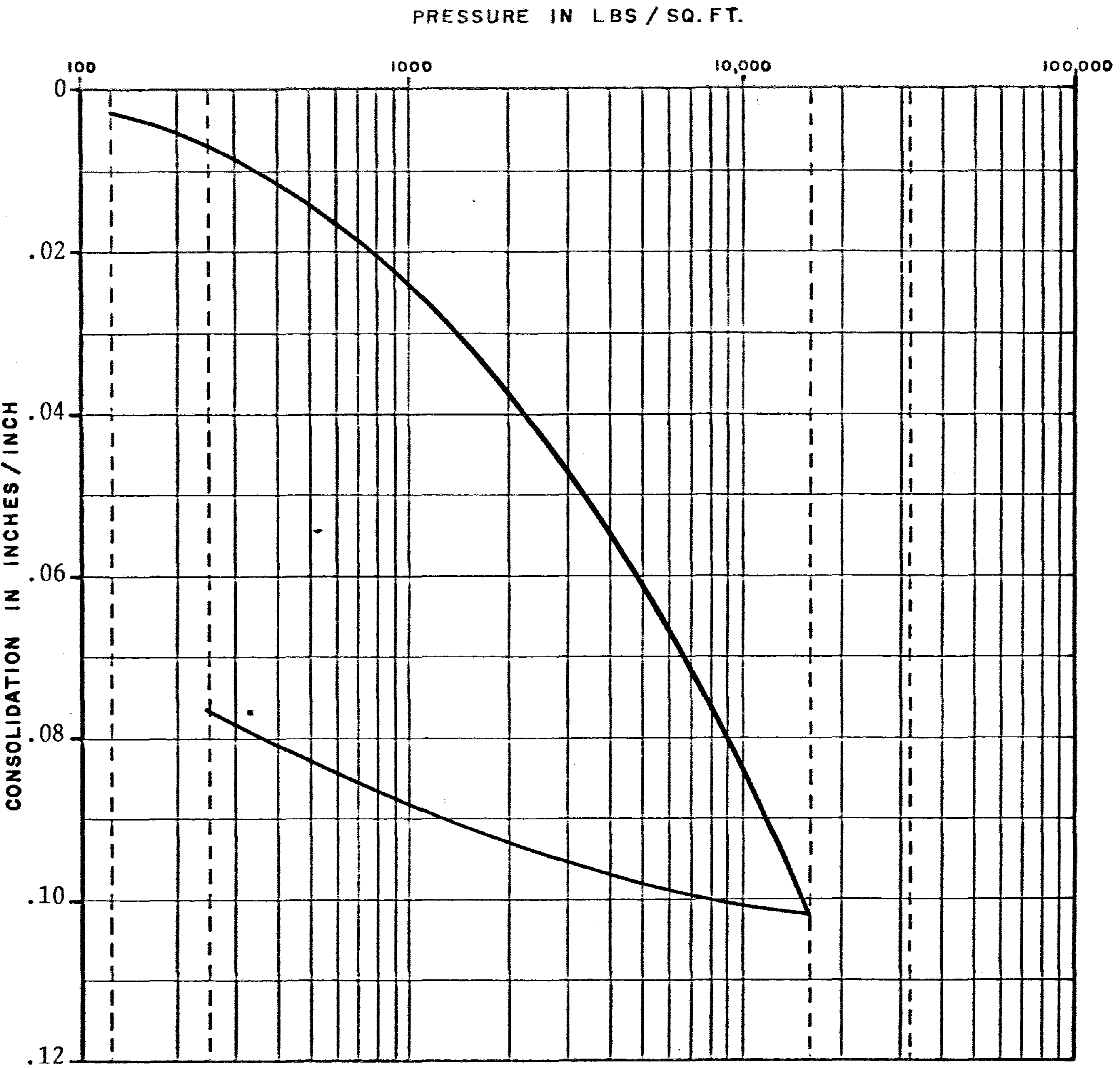
CONSOLIDATION TEST DATA

(ASTM D 2435-70)

Plate A9

DRAWN BY ________ DATE ________
CHECKED BY ________ DATE ________

JOB NUMBER ________ NAME ________
LOCATION Stevens Creek



KEY	BORING	DEPTH	SOIL DESCRIPTION	NATURAL MOISTURE CONTENT%	NATURAL DRY DENSITY (P.C.F.)	EFFECTIVE OVERBURDEN PRESSURE (P.S.F.)	MAX. EFF. PAST PRESSURE (P.S.F.)
—	10	15½	silty sand, brown	31	94	1300	2100

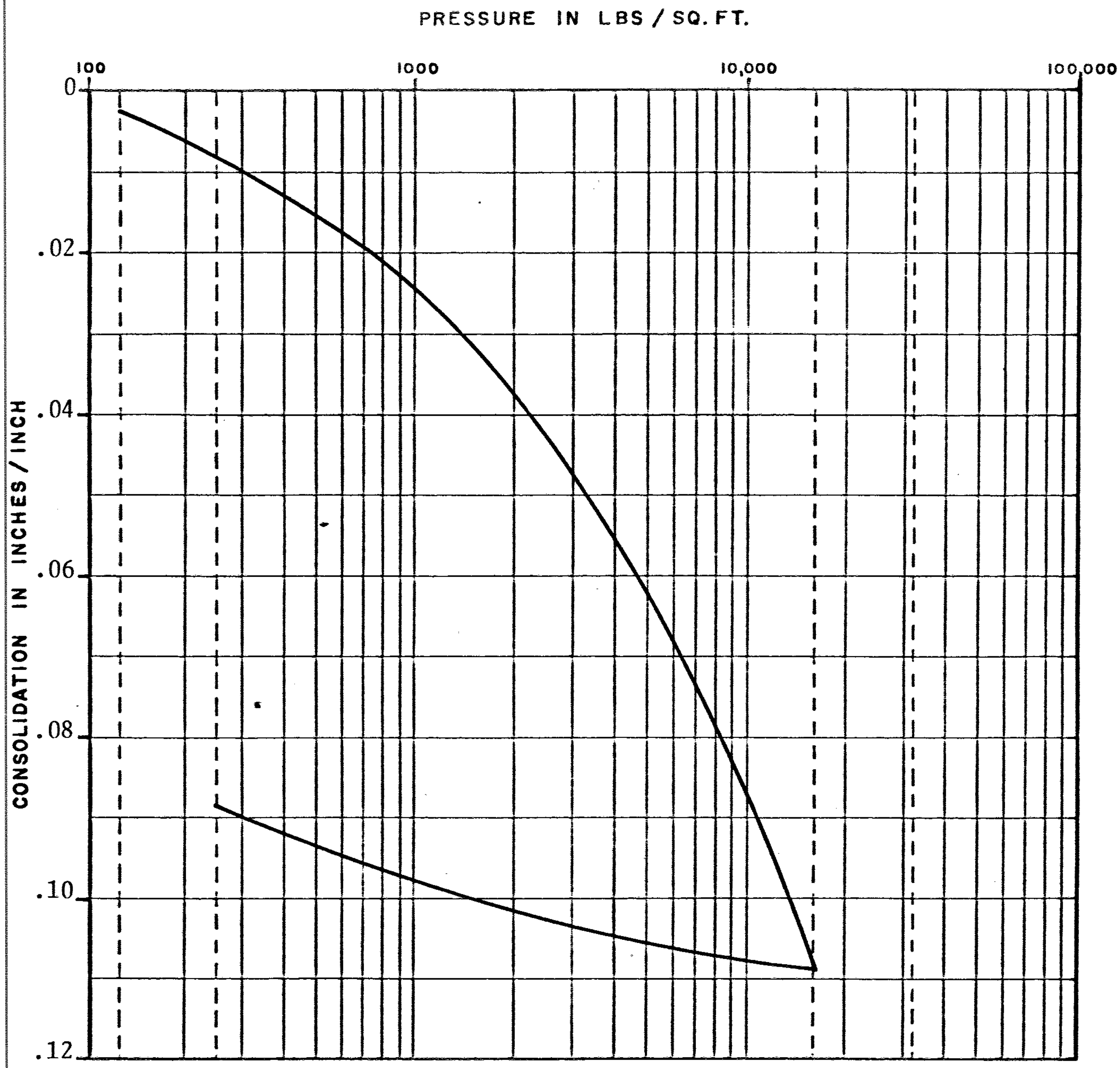
CONSOLIDATION TEST DATA

(ASTM D 2435-70)

Plate A10

DRAWN BY ______ DATE ______
CHECKED BY ______ DATE ______

JOB NUMBER ______ NAME ______
LOCATION Stevens Creek



KEY	BORING	DEPTH	SOIL DESCRIPTION	NATURAL MOISTURE CONTENT%	NATURAL DRY DENSITY (P.C.F.)	EFFECTIVE OVERBURDEN PRESSURE (P.S.F.)	MAX. EFF. PAST PRESSURE (P.S.F.)
—	12	5	Silty clay, black	31	90	650	2000

CONSOLIDATION TEST DATA

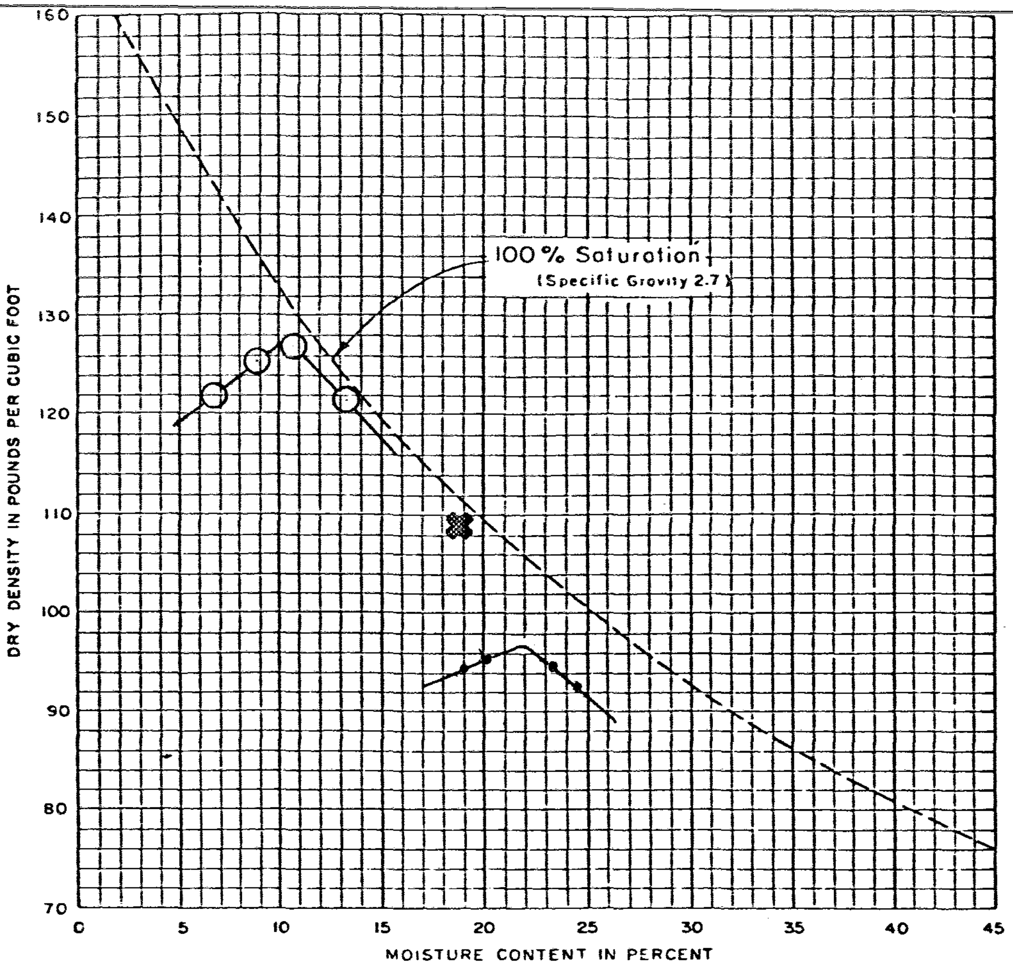
(ASTM D 2435-70)

Plate A11

Berlogar, Long & Associates

Job Number 915-40 Client SCVWD
Location Mountain View, Stevens Creek

Drawn By ______ Date ______
Checked By ______ Date ______



COMPACTION METHOD:

☐ ASTM D 698 (OR AASHO T 99)
☒ ASTM D 1557/70 (OR AASHO T 180)
☐ CALIF. 216
☐ OTHER ______

LEGEND	✖	—○—	—●—
BORING or SAMPLE NUMBER	TP-1	TP-5	TP-19
DEPTH (FEET)	1½ – 8	2 – 4	1 – 5
SOIL DESCRIPTION	clay, brown	sandy silt, gray-brown	clay, gray-blue
SOURCE OF MATERIAL	–	–	–
USE OF MATERIAL	–	–	–

OPTIMUM MOISTURE CONTENT (%)	17.5	10.4	21.5
MAXIMUM DRY DENSITY (PCF)	109.1	127.6	96.5

SINGLE POINT

COMPACTION TEST DATA

Plate A12

APPENDIX B

NASA FILL BORROW SOURCE

APPENDIX B

NASA Borrow Source

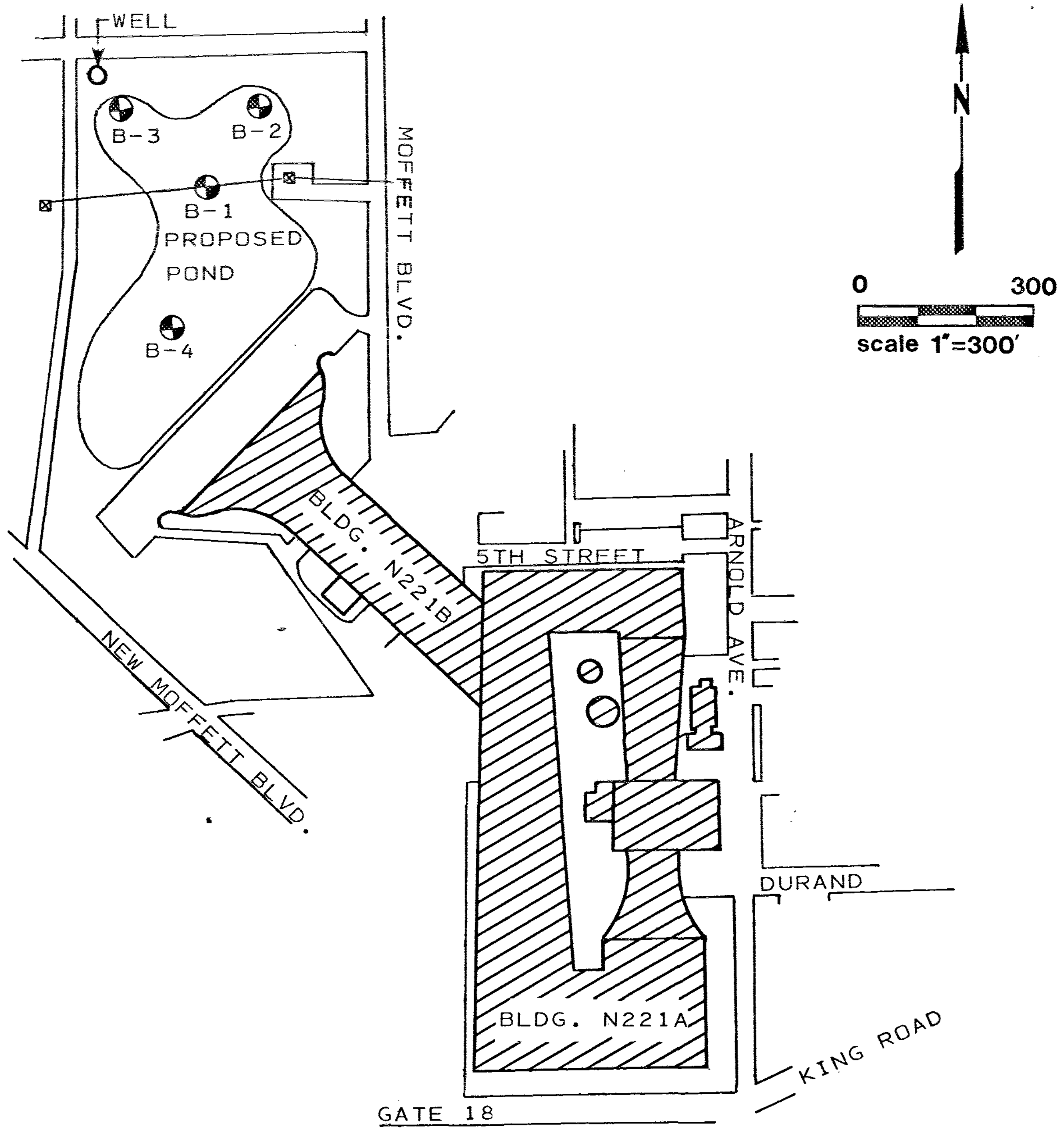
NASA is planning to construct a pond at the mouth of a wind tunnel (Building N221B) for the Ames Research Center. They have offered excavation materials to the Santa Clara Valley Water District for levee construction. The pond is to be excavated from 5 to 6 feet below the present ground surface and will be lined.

The project location is shown on the Vicinity Map, Plate 1, and the pond configuration and exploration details are shown on the Site Plan, Plate B1. Boring Logs and Atterberg Limits are presented on the attached Plates B2 through B6.

Our exploration indicates that the southern portion of the site contains shallow thickness of gravel fill. This area is presently used as a construction storage yard. Our exploration was limited in this area because of construction equipment and materials. The site is blanketed with a four- to five-feet-thick layer of highly expansive silty clay topsoil (expansive soils change volume with changes in moisture content). This strata is underlain by discontinuous and interbedded layers of silty and gravelly sands and sandy clay. Groundwater was encountered at depths of 6½ to 7½ feet.

Based on the results of our exploration and knowledge of these general soil characteristics, we conclude that the materials excavated from the NASA borrow source can be used in levee construction provided the expansive soil is capped in accordance with our recommendations. The high groundwater could create problems during construction, especially if the pond clay liner is to be compacted. Pumping soils and sinking of heavy equipment would make compaction extremely difficult to achieve.

JOB NUMBER: 915-40 DATE: 6-30-81 BY: DK



SITE PLAN

NASA BORROW SOURCE

FOR

SANTA CLARA VALLEY WATER DISTRICT

EXPLANATION

● B-4 BORING LOCATION

BASE: A PORTION OF A PLOT PLAN PROVIDED BY MR. GEORGE HOLDAWAY, NASA FACILITIES PLANNING, AT A SCALE OF 1''=300'.

BORING LOG B-1 NASA

JOB NO: 915-40

DATE DRILLED: 6-24-81

JOB NAME: SCVWD, Stevens Creek

SURFACE ELEV.:

EQUIPMENT: DRILLING Flight Auger

DATUM:

SAMPLER TYPE	DRIVE WEIGHT-LB	HEIGHT OF FALL-IN
2.43" ID Split Spoon	140	30

Sample Depth ft.	Blows per ft	Moisture Content %	Dry Unit Weight p.c.f.	Depth in feet	USCS Classi-fication	Description
	45				CH	Silty clay, black, moist, very stiff
						Becomes sandy
						Silty gravelly sand, light brown, wet, dense
	24			5	SM	
					▽	Water level @ 7½ feet
	30					Becomes gravelly at 9½ to 10 feet
				10		
						Total depth 10', water at 7½ ft.

BORING LOG B-2NASA

JOB NO: 915-40
DATE DRILLED: 6-29-81

JOB NAME: SCVWD, Stevens Creek
SURFACE ELEV.:
EQUIPMENT: DRILLING Flight Auger
DATUM:

SAMPLER TYPE	DRIVE WEIGHT-LB	HEIGHT OF FALL-IN
2.43"ID Split Spoon	140	30

Sample Depth ft.	Blows per ft	Moisture Content %	Dry Unit Weight p.c.f.	Depth in feet	USCS Classification	Description
	20				CH	Silty clay, brown to black, damp to moist, very stiff
	42				CL	Sandy clay with silt, light tan, moist, very stiff, minor caliche
		18.9	100	5		
					▽	Increasing sand content with depth Water at 7½ feet
	15			10		
						Boring terminated @ 11 ft. Water encountered @ 7½ ft.

BORING LOG B-3NASA

JOB NO: 915-40
DATE DRILLED: 6-24-81

JOB NAME: SCVWD, Stevens Creek
SURFACE ELEV.:
EQUIPMENT: DRILLING Flight Auger
DATUM:

SAMPLER TYPE	DRIVE WEIGHT-LB	HEIGHT OF FALL-IN
2.43"ID Split Spoon	140	30

Sample Depth ft.	Blows per ft	Moisture Content %	Dry Unit Weight p.c.f.	Depth in feet	USCS Classi-fication	Description
	25				CH	Silty clay, black, damp to moist, very stiff
	100+			5	SP	Gravelly sand, brown, wet, very dense,
					∇	Water level 6/24/81
	64			10		
						Boring terminated at 10 ft. Water encountered @ 6½ ft.

BORING LOG B-4NASA

JOB NO: 915-40

DATE DRILLED: 6-24-81

JOB NAME: SCVWD, Stevens Creek

SURFACE ELEV.:

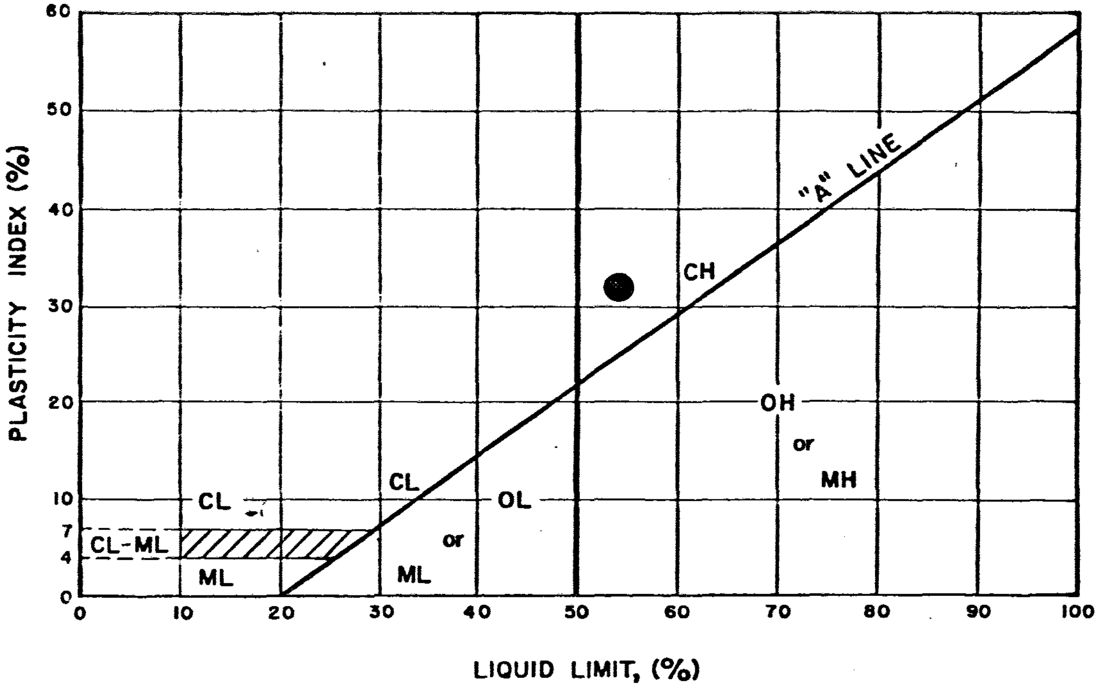
EQUIPMENT: DRILLING Flight Auger

DATUM:

SAMPLER TYPE	DRIVE WEIGHT-LB	HEIGHT OF FALL-IN
2.43"ID Split Spoon		

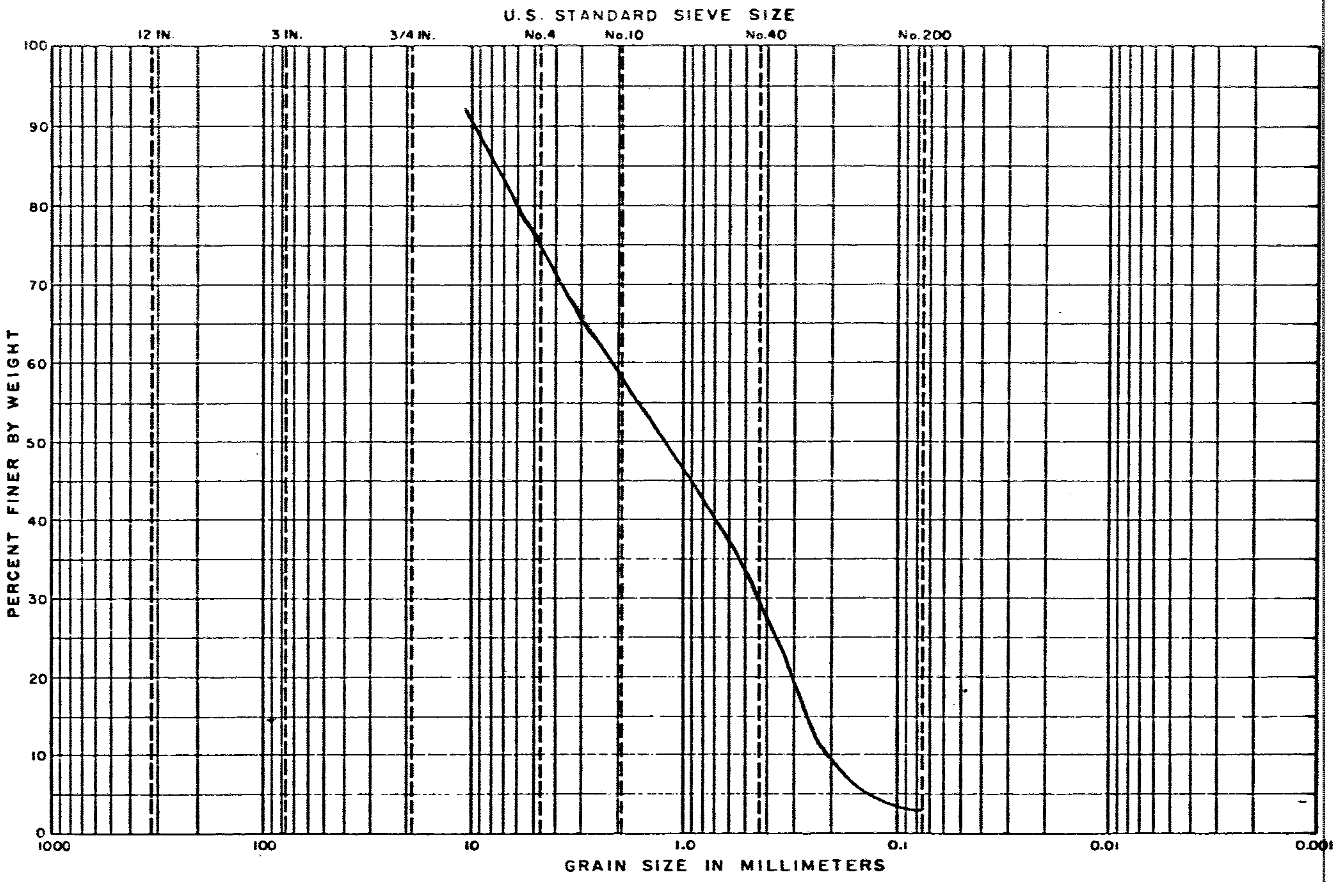
Sample Depth ft.	Blows per ft	Moisture Content %	Dry Unit Weight p.c.f.	Depth in feet	USCS Classification	Description
	27				CH	Silty clay, black, damp, stiff
						Becomes light gray with trace of sand
	55			5		Gravelly sand, gray, saturated, very dense
					SP	
					▽	Water level 6/24/81
	56			10		
						Boring terminated at 10 ft. Water encountered at 7 ft.

SUMMARY OF ATTERBERG LIMITS



SYMBOL	BORING NO.	DEPTH, FT.	LIQUID LIMIT, %	PLASTICITY INDEX, %	USC SYMBOL
●	B-3 NASA	1½	54	32	CH

Job Number ____ Client ____ Drawn By ____ Date ____



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

(UNIFIED SOIL CLASSIFICATION SYSTEM)

LEGEND	—•—		
BORING NUMBER	B-1 NASA		
DEPTH (FEET)	9½		
SOIL DESCRIPTION	Gray gravelly sand		
EFFECTIVE SIZE, D_{10}			
COEFFICIENT OF UNIFORMITY D_{60}/D_{10}			
COEFFICIENT OF CURVATURE $D_{30}^2/(D_{10} \times D_{60})$			

GRADATION TEST DATA